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AN

INTRODUCTION TO MINERALOGY:

FOUNDED ON THE

CHEMICAL COMPOSITION

OF

MINERAL AND METALLIC BODIES.

BY

CHARLES MOXON,

FOREIGN SECRETARY OF THE SCIENTIFIC SOCIETY.

[*Extracted from the* MINING REVIEW—*Vol. I.*, *New Series.*]

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PREFACE.

CONSIDERING the disadvantages which are felt by all persons who commence the study of Mineralogy, both on account of the want of system, and in many cases the voluminous authors on the subject, I have been induced to form an introduction to the science, which, I hope, cannot fail to be productive of advantageous results. The fundamental arrangements upon which this system has been formed, may, perhaps, be a sufficient recommendation for the Treatise, as the chemical arrangement has always been observed, and consequently the composition can be more correctly asserted in the greatest number of cases, and the minerals placed under their respective heads. But in so doing, three important subjects have always to be kept in view.

I. The characteristic component.
II. The actual composition.
III. The deviations from the common rule.

And, added to these, the general characteristics. In the first case, the characteristic components or constituent parts are not always predominant (ex. glucinite); in the second case, to form a chemical classification in which every constituent would enter into the name of the mineral, would make the nomenclature so lengthened and difficult for study, that though it might be more accurate, still the great point to be always kept in view, " to make the subject as clear and as simple as possible," would be lost. For this purpose I have adopted the classes; and under these heads those minerals which agree in chemical composition will be found. Lastly, traces of chemical elementary bodies, though perceptible in some specimens, are absent in others of the same species.

In conclusion, as a member of a society which is endeavouring to advance science by elementary introductions, to the various branches of scientific knowledge, I trust that this Treatise may be attended by those benefits which we anticipate.

CHARLES MOXON.

Leyton, Essex, August 2*d*, 1838.

AN

INTRODUCTION TO MINERALOGY.

BY CHARLES MOXON.

[Extracted from the "MINING REVIEW," Vol. V.—New Series.]

There are many and great difficulties which arise when contemplating a new scientific classification of substances, as there are so many characteristics which must be taken into consideration in order to arrive at some certain order; and at the same time all cannot be made use of in naming them, without bringing the whole into very great confusion. If we take a view of the system of mineralogy already adopted, we find that they have been classified differently, but without actual change of name, though in some instances one name is substituted for another. The present mineralogical nomenclature is of mixed origin; some deriving their appellations from scientific persons, who first recognised them as separate substances; some from the place where they were first discovered; some are of Greek or Latin origin; and the remainder are named according to their chemical nature, as carbonate of lime, &c. &c. Thus we see a diversity of nomenclature entering into one mineralogical arrangement, the names for the most part conveying no idea of the substance to which they relate, but either derived from Latin or Greek, or from the original place where a mineral was first found (but now to be found in numerous other places), or from a noted mineralogist, serving not to denote the mineral, but to hand his name down from one generation to another; and some are upon firmer grounds, as those founded upon chemistry. This last, is the most perfect principle, and conveys an idea of a mineral, in itself very distinct, and certainly of great use. Though it would be almost impossible to name every mineral, on account of the number which bear a chemical affinity to each other, I have reduced them under a certain number of heads, to which I have added the class of minerals which they comprehend. There are only three classes, viz.:—I. Earthy minerals, divided into nine subspecies, from the nine different elementary earths, which are among the chemical elements. I should, however, add, that these have been reduced to metallic bases. I shall not refer to these in any way in the arrangement, as it would only tend to confuse, rather than throw any light upon the subject. II. Native metals. III. Inflammable minerals.

CLASS I.

EARTHY MINERALS.

	New System.	Old System.
1. Zirconite.	.. ..	Zircon.
.. ..	Ferro zirconite.	Hyacinth.
2. Glucinite.	.. ..	Emerald, euclase.
.. ..	Alumino glucinite.	Beryll.
3. Silicite.	.. ..	Quartz.
.. ..	Hydro-silicite.	Cat's-eye, opal, flint, menilite.
.. ..	Alumino silicite.	Chalcedony, cornelian, onyx, agate, jasper, hornstone.
.. ..	Calc-silicite.	Zeolite, chabasite, stilbite, silicious sinter.
.. ..	Ferro-silicite.	Lievrite, garnet, cinnamon-stone.
.. ..	Calcalumino-silicite.	Idocrase, prehnite, heulandite scolezite, Wernerite zoisite, epidote.
.. ..	Ferro-calc-silicite	Axinite, Indianite, lapis lazuli.
.. ..	Ferro-alumino-silicite.	Tourmaline.
.. ..	Hydr. alumino-silicite.	Slate, clay, fahlunite.
.. ..	Baryti-silicite.	Harmatome.
.. ..	Magnesi-calc-silicite.	Augite, sahlite, fassaite, euchysiderite, hornblende, pargasite, hedenbergite.
.. ..	Magnesi-silicite.	Tremolite, schiller spar, asbestos, kyanite, staurolite.
.. ..	Potassi-silicite.	Jade, obsidian, gabronite, petalite.
4. Magnesite.	.. ..	Magnesia.
.. ..	Hydro-magnesite.	Hydrate of magnesia.
.. ..	Alumino-magnesite.	Pleonaste, iolite.
.. ..	Silico-magnesite.	Chrysolite.
.. ..	Ferro-magnesite.	Olivine, condrodite.

	New System.	Old System.
Magnesite.	Calc-silico-magnesite.	Serpentine.
.. ..	Hydro-silico-magnesite.	Steatite, chlorite.
5. **Yttrite.**	.. ..	Gadolinite.
6. **Aluminite.**	.. ..	Aluminite.
.. ..	Fluor-aluminite.	Topaz, kollyrite.
.. ..	Potassi-silica-aluminite	Mica.
.. ..	Potass-aluminite.	Lepidolite, nacrite.
.. ..	Hydro-potass-aluminite.	Haüyne, felspar, scapolite.
.. ..	Calc-silica-aluminite.	Meionite, sommite, talc.
.. ..	Ferro-potass-aluminite.	Schorl, killinite, mellinite, rubellane.
.. ..	Potassi-calc-aluminite.	Clinkstone, pitchstone, lava, basalt, pumice.
.. ..	Hydr. aluminite.	Wavellite.
7. **Calcite.**	.. ..	Chalk.
.. ..	Carboni-calcite.	Carbonate of lime.
.. ..	Stronti-calcite.	Arragonite.
.. ..	Magnesi-calcite.	Bitter spar, pearl spar, brown spar, dolomite.
.. ..	Phosphori-calcite.	Apatite.
.. ..	Fluori-calcite.	Fluor.
.. ..	Sulphuri-calcite.	Anhydrite, vulpinite, gypsum
.. ..	Nitro-calcite.	Nitrate of lime, dathalite.
.. ..	Bora-magnesi-calcite.	Boracite.
8. **Baryte.**	.. ..	Barytes.
.. ..	Carboni-baryte.	Witherite.
.. ..	Sulphuri-baryte.	Heavy spar.
9. **Strontite.**	.. ..	Strontia.
.. ..	Carboni-strontite.	Strontianite.
.. ..	Sulphuri-strontite	Celestine.

MINERALS PRINCIPALLY ACIDIFEROUS.

10.	Alumino-potassite.	Alum.
.. ..	Nitra-potassite.	Nitre.
.. ..	Carbo-sadalite.	Natron.
.. ..	Boro-sadalite.	Borax.
.. ..	Murio-sadalite.	Salt.

CLASS II.

NATIVE METALS.

	New System.	Old System.
1. Platina.	.. ..	Platina.
2. Palladium.	.. ..	Palladium.
3. Iridium.	.. ..	Iridium.
4. Osmium.	.. ..	Alloy of iridium and osmium
5. Gold.	.. ..	Gold.
6. Silver.	.. ..	Silver.
.. ..	Antimonial silver.	Antimonial silver.
.. ..	Molybdic silver.	Molybdic silver.
.. ..	Sulphuret of silver.	Sulphuret of silver.
.. ..	Bismuthic silver.	Bismuthic silver.
.. ..	Carbonate of silver.	Carbonate of silver.
.. ..	Muriate of silver.	Muriate of silver.
7. Mercury.	.. ..	Mercury.
.. ..	Sulphuret of mercury.	Cinnabar.
8. Copper.	Ferrate of copper.	Grey copper.
.. ..	Sulphuret of copper.	Copper pyrites.
.. ..	Oxide of copper.	Red oxide of copper.
.. ..	Carbonate of copper.	Carbonate of copper, chrysocola.
.. ..	Sulphate of copper.	Blue vitriol.
.. ..	Phosphate of copper.	Phosphate of copper.
.. ..	Arseniate of copper.	Arseniate of copper.
9. Iron.	Sulphuret of iron.	Iron pyrites.
.. ..	Aluminate of iron.	White iron pyrites.
.. ..	Magnetic sulpht. of iron.	Magnetic iron.
.. ..	Oxide of iron.	Oxide of iron.
.. ..	Oligistic iron.	Specular iron.
.. ..	Hydrate of iron.	Red iron ore.
.. ..	Hydro-silicate of iron.	Brown iron ore.
.. ..	Silicate of iron.	Jaspery iron ore.
.. ..	Carbonate of iron.	Spathose iron.
.. ..	Phosphate of iron.	Blue iron ore.
.. ..	Sulphate of iron.	Green vitriol.
.. ..	Chromate of iron.	Chromate of iron.
.. ..	Arseniate of iron.	Arseniate of iron.
.. ..	Oxalate of iron.	Oxalate of iron.
10. Manganese.	.. ..	Manganese.

	New System.	Old System.
MANGANESE.	Silicate of manganese.	Siliferous oxide.
.. ..	Oxide of manganese.	Oxide of manganese.
.. ..	Sulphuret of manganese.	Sulphuret of manganese.
.. ..	Carbonate of manganese.	Carbonate of manganese.
11. ARSENIC.	.. ..	Arsenic.
.. ..	Sulphuret of arsenic.	Realgar.
.. ..	Oxide of arsenic.	Arsenic bloom.
12. BISMUTH.	.. ..	Bismuth.
.. ..	Sulphuret of bismuth.	Sulphuret of bismuth.
.. ..	Carbonate of bismuth.	Carbonate of bismuth.
13. ANTIMONY.	.. ..	Antimony.
.. ..	Sulphuret of antimony.	Grey antimony.
.. ..	Oxide of antimony.	Red antimony.
14. MOLYBDENA.	.. ..	Molybdena.
.. ..	Sulphuret of molybdena.	Sulphuret of molybdena.
.. ..	Oxide of molybdena.	Oxide of molybdena.
15. TELLURIUM.	.. ..	Tellurium.
16. TIN.	.. ..	Tin.
.. ..	Oxide of tin.	Oxide of tin.
.. ..	Sulphuret of tin.	Sulphuret of tin.
17. TUNGSTEN.	.. ..	Tungsten.
18. TITANIUM.	.. ..	Titanium.
19. SPHENE.	.. ..	Sphene.
20. CERIUM.	.. ..	Cerium.
21. URANIUM.	.. ..	Uranium.
22. COLUMBIUM.	.. ..	Columbium.
23. CHROME.	.. ..	Chrome.
24. COBALT.	.. ..	Cobalt.
.. ..	Sulphuret of cobalt.	Sulphuret of cobalt.
.. ..	Arseniate of cobalt.	Bright white cobalt.
.. ..	Oxide of cobalt.	Cobalt bloom.
.. ..	Sulphate of cobalt.	Red vitriol.
25. NICKEL.	.. ..	Nickel.
26. LEAD.	.. ..	Lead.
.. ..	Sulphuret of lead.	Galena.
.. ..	Carbonate of lead.	Carbonate of lead.
.. ..	Muriate of lead.	Muriate of lead.
.. ..	Phosphate of lead.	Phosphate of lead.
.. ..	Arseniate of lead.	Arseniate of lead.
.. ..	Sulphate of lead.	Sulphate of lead.

	New System.	Old System.
LEAD.	Molybdate of lead.	Molybdate of lead.
27. **ZINC.**	.. ..	Zinc.
.. ..	Sulphuret of zinc.	Blende.
.. ..	Red oxide of zinc.	Red oxide of zinc.
.. ..	Carbonate of zinc.	Carbonate of zinc.

CLASS III.

INFLAMMABLE MINERALS.

DIAMOND.	.. ..	Diamond.
SULPHUR.	.. ..	Sulphur.
COAL.	.. ..	.. ..
.. ..	Bovey coal.	Bovey coal.
AMBER.	.. ..	.. ..

Here we have then, comprised under three heads, the products of the mineral kingdom—the chemical name either denoting one or a class of several minerals, as stated.

Let us now look at the peculiarities of minerals, and the reference they have with other sciences. It may, perhaps, be at first rather disheartening to the student of mineralogy if he be told that several sciences are the natural accompaniments of this one, though the knowledge of all is not necessary in all cases. The thorough practical mineralogist alone requires them all, so as to be able to turn them to account in ascertaining a mineral body; on the contrary, a person wishing only to be able to distinguish one from another, may be content with the outward signs, or physical mineralogy, as I term it.

The three sciences of mineralogy, chemistry, and physics, are so connected together that the one naturally leads to the other. Suppose we have a mineral unknown to us which we wish to find out, agreeing in physical character with many other varieties, the first mode of distinction resorted to for analysis is chemistry, as the most certain method of distinguishing them. Should crystallography be your particular branch, you cannot proceed well without a knowledge of mathematics, and more particularly of geometry. Again, if we view the connection this science has with geology—two sciences, although entirely different, very intimately connected, as being branches of one and the same, we find we are led on to contemplate natural history, in the form of fossil osteology, fossil botany, and fossil conchology—all of which sciences have a reference to physics. The great revolutions which have taken place on the surface of our earth have been the effects of mechanical compression in some instances, and of a general eruption, caused likewise by the physical agency, in others.

Minerals have general characteristics by which they may be distinguished from one another. These characters are—solidity, liquiform or æriform, colour, taste, smell, appearance, porosity, opacity, lustre, and tenacity. Most minerals are solid in their native state, though they change appearances perhaps when exposed to heat; and a few occur liquid, as mercury, which on exposure to heat assumes the æriform state. The colour of minerals is a very prominent distinguishing mark, by which in many cases the species of a mineral may be made out, and the diversity of shades of one colour makes it in some cases a matter of no little difficulty to be able to do so. There is scarcely a colour which is not to be found in the mineral kingdom, and many, of great use, are found in it only. Another distinguishing mark is taste, though it is rarely resorted to. Clayey minerals have a very peculiar taste, as also some metals, as arsenic and iron. The smell is not always to be detected, though in most cases a clayey substance can be told by the smell which it gives out when breathed on. By appearance the species of a mineral is detected, as, for instance, whether it is mammilated, compact, crystallised, earthy, or so on. When accustomed to the sight of minerals it is by appearance almost entirely that you determine a mineral, though it would be impossible to do so at first; but the eye becomes gradually accustomed to its form, colour, and general characteristics, till at length it is enabled to determine with almost unerring certainty not only the mineral itself, but also the variety to which it belongs. Very few minerals are porous to the eye (that is, penetrated by holes), though numbers are invisibly perforated by very minute openings between the pieces. Pumice is visibly porous, and absorbs water easily. Some minerals are opaque, that is, they do not permit the rays of light to pass through them; whilst others, as quartz, are in some cases so transparent, that objects may be distinctly seen through them—this we denominate transparency; or, when the contrary takes place, opacity.

ZIRCONITE (*zircon*, Phillips; *jargon*, Romé de Lisle; *zirkon*, Werner).—This class of minerals is divided into three orders—the zircon, jargoon, and hyacinth—all of which differ but little in their composition; their external colour is also much alike, varying from red to grey, and rarely green or white, and they all occur crystallised. The primitive form is an obtuse octahedron, and it occurs principally in the form of a rectangular four-sided prism, truncated on the lateral edges. It possesses the property of double refraction in some degree—spec. gravity 4,557. Before the blowpipe this class of minerals is infusible, and the analysis of Klaproth determines its composition to be zirconia 69, silica 26.50, and oxide of iron 0.50. In the hyacinth the iron is much more abundant, being on an average about 2 per cent. It occurs in Auvergne, near Enpailly, in a volcanic sand; in Spain, Silesia, Italy, and Bohemia; and it occurs in sienite in Norway. It is also found in Ceylon, Siberia, and Java, and is of frequent occurrence in the primitive rocks of North America. The zirconite of Phillips occurs in the same form, though sometimes the chemical composition varies by the addition of a small quantity of titanium. The colour of all the classes of zirconite can be destroyed by heat.

GLUCINITE (*emerald*, Phillips; *smaragd*, Werner).—This class, which includes those minerals commonly known by the name of emerald, euclase, and beryll, derives its name from the chemical element *glucina*, which is contained in all the varieties (and in this class only)—whence its rarity. The colour of all the varieties is a green, of different degrees of intensity, sometimes passing into bluish green, and more transparent according to the size, the smaller varieties being almost entirely opaque. They all occur crystallised in small six-sided prisms, and the varieties are produced by the terminal angles being replaced by planes, or by the solid angles by triangular planes. The variety known by the name of *euclase* is exceedingly frangible. The constituent parts of the emerald are, silica 64.5, alumina 16, glucina 13, oxide of chrome 3.25, lime 1.6, and water 2; and its colour is believed to be owing to the presence of chrome. It is found principally in Peru; it also occurs in Salzburg, and in Ethiopia. It is principally met with in primitive rocks, more particularly mica slate, though sometimes in the sand of rivers. Its colour causes it to be much used in jewellery, though the pure transparent varieties are scarce. The beryll (alumino glucinite) is hardly distinguishable from the emerald on account of its strong resemblance in outward appearance. The crystals of the beryll are longer than those of the emerald, and the proportion of glucina is smaller in this variety than in the former. The specific gravity of this class is from 2.650 (Werner) to 2.722 (Brisson), and the varieties are all with difficulty fusible before the blowpipe.

SILICITE *(quartz,* Phill., Jamieson; *quartz,* Werner).—It comprehends a great variety of minerals, differing only in their colour and outward appearance, their composition, with the exception of a foreign metal, to which the different varieties owe their colours, being the same. They occur both massive and crystallized; the regular form is a six-sided prism acutely terminated, generally in groups, and rarely single. When two pieces of quartz are rubbed together they become phosphorescent, which property is very visible at times. Silicite, as its name denotes, consists almost entirely of silex, this earthy element being in the proportion of 99, with 1 per cent. of water of crystallisation. The white quartz occurs in almost every country—in primitive rocks, with various metals and earths, and sometimes beautifully aggregated. In England the finest specimens are from Cornwall, in France from Dauphiné and Auvergne, and also in the Alps, Bohemia, Saxony, and Sweden, and in the New World and the remaining continents it is equally abundant.

Purple quartz or amethyst is a variety in which alumina enters into the composition, though in a very small proportion, and in some specimens a trace of manganese has been detected (*vide* Rose Karsten's Tabell, s. 23). It is found in Scotland and Ireland, in Sweden, Saxony, Spain, France, and Hungary, both massive and crystallised, and also near Guanaxuato, in Mexico. Its colour is a bright purple or violet, bordering on pearl grey.

Rose quartz is distinguished again by its colour, which is supposed to be produced by manganese, and like the preceding variety, occurs both massive and crystallised. It is found in Bohemia, Bavaria, Spain, and France, and in Greenland and the United States in North America.

Yellow quartz has received the various appellations of Cairnghorm topaz and Bohemian topaz, on account of the resemblance it bears to that beautiful gem, and from its locality; and in addition to the above-mentioned places, it occurs in several of the mines in Cornwall.

Ferruginous quartz is the result of the admixture of a consider able portion of iron with the silex, which gives it a rusty brown opaque appearance, by which it is characterised. The German name Eisenkiesel (iron gravel), implies at once its composition; and the appearance of some of the specimens of this variety of quartz bears a strong resemblance to gravel, though the terminated six-sided prism is still preserved. It is found in Saxony, Bohemia, Spain, Altenburg, Siberia, and North America.

Brown quartz accompanies the yellow varieties in most of its localities, and is generally of a smoky brown colour, whence its French appellation—Quartz hyalin enfumé.

Hyalite is a variety of quartz which is found investing the cavities of rocks, somewhat similar to silicious sinter, though more transparent. It occurs in Tuscany, Silesia, Germany, near Frankfort, and Mexico.

Arenaceous quartz or sand is a variety of quartz of so common occurrence that I need hardly make any mention of it. It is conjectured to have originated from the destruction of quartz. Its colour, which is principally yellowish white, passes into every shade of the various blue, green, black, red, and yellow tints.

HYDRO SILICITE (includes *opal, hydrophane, menilite, flint).* —This is the second class in the silicious genus, and its composition varies from a small to a larger proportion of water with silica, for though the preceding class contains a small proportion of the same water of crystallisation, the minerals in that class cannot be reckoned under this head. The *hyalite* is the only one which approaches this chemical composition, the average of water being about 6 per cent. The *cat's-eye,* the most precious of the class denominated opal, occurs in small grains, of a yellowish or brownish grey colour, and imbedded in sand or primitive rock. *Precious opal* is nearly allied to this mineral, and contains 19 per cent. of water, the only difference being the size in which it occurs, and the additional splendour, on which account it has received the name of *fire opal;* it occurs in primitive rocks, very frequently lining cavities in those of plutonic origin, and though not abundant, it is met with in various places, more particularly in the Alps, in Bohemia, at Freyberg, and in North America (Phillips has accounted precious opal and fire opal different varieties, *vide* Phillips Min. p. 9). *Common opal* is intermediate between this last variety and the *semi opal*, possessing the resinous appearance of the former, but approaching the latter in opacity. The colour is principally yellow, though it is found of various shades of grey, and it occurs more frequently than any variety of opal; the finest specimens, however, are from Cornwall. The *semi opal* is known by its decided opacity, and is in general striated, some parts being more transparent than others, though it is sometimes uniform in appearance. The very beautiful variety, known by the name of *wood opal*, occurs in Hungary, and is generally of a silky white or yellowish white colour, tinged in places by iron; it is much lighter than the preceding varieties, and is easily distinguishable by its fibrous, wood-like appearance.

Hydrophane is nearly allied to the foregoing class of minerals, both in general appearance and composition, the only difference is, that the proportion of water is smaller than in the preceding varieties, and consequently it is considered a variety of opal. It occurs in Bohemia, Saxony, and South America.

Menilite (*leber opal*, Reuss; *menilith*, Leonhard).—It is of a slaty texture, somewhat approaching the appearance of chalk, and nearly allied to semi opal. It contains 12 per cent. of water, and is found in the formation round Paris. *Flint* occurs of a variety of colours, generally however of shades of grey and black; it contains a smaller quantity of water, but little more than 3 to 4 per cent., and in some cases even less. It is found in the chalk formations in regular beds, and in nodules which frequently contain quartz crystals. The specific gravity of this class averages about 2.50, and the appearance is intermediate between silicite and *alumino silicite*.

ALUMINO SILICITE (*chalcedony, onyx, plasma, heliotrope, chrysoprase, cornelian, agate, jasper, hornstone*).—It forms a very important division of the silicious minerals, both on account of the number of specimens which are classed under it, and also on account of their splendour, for this reason they are much employed for ornamental purposes. The *common chalcedony* is nearly allied to flint in appearance when broken, though the botryoidal form in which it occurs at once distinguishes it from that mineral. It contains 16 per cent. of alumine, and 84 of silex. Its colour is grey for the most part, and semi-transparent or translucent. It occurs in almost every country of both hemispheres, and the finest specimens are from Siberia and Hungary. *Onyx* is formed of layers of brown and white chalcedony, and is used in jewellery. In combination with *sard,* a mineral of the same class, but of a reddish brown colour, it forms *sard-onyx,* an alternation of the sard with layers of white chalcedony. *Plasma* is a variety of chalcedony of a light-green colour, over the surface of which small red spots are visible. It is principally obtained in Moravia and Italy. The *heliotrope* is very similar to the foregoing species, the difference consisting in the colours being darker, and the red spots more positive—in some specimens, particularly in those from Bohemia, the red predominates. It is found also at various parts of Scotland and in Siberia, and is used in jewellery. *Chrysoprase* is of a fine green colour, generally uniform. Its principal ingredient is quartz (96 per cent.), and in addition it contains a small quantity of alumina and also lime. The finest specimens are from Greenland and Spain. The *cornelian* another very useful gem, is of a beautiful red or white colour in some instances, sometimes uniform, at others beautifully marked in a circular form. It is of frequent occurrence, being found not only in different countries on the Continent, but also in considerable quantities on the coasts of Scotland and Wales. Being softer than common chalcedony it is used for engraving, and it bears a very high polish. *Agate* is a compound mineral, composed of alternate layers of different varieties of chalcedony, for instance, the common chalcedony and cornelian with amethyst, white quartz, and hornstone, but the first-mentioned minerals predominate. The fortification agate derives its name from its appearance, as do the moss, and also the ribbon agates. The most beautiful varieties are from Oberstein, mostly occurring very large, and of which I have several very fine specimens. The *jasper* is a similar mineral, though the ingredients are not so numerous, silex still predominating with a small quantity of iron and alumina. It is found in Cornwall and on most of our coasts, and in great quantities in Egypt, and was mentioned at very early times as being of great use for ornamental purposes. *Hornstone* has not been carefully analysed, though in those cases where chemistry has lent its aid to the detection of its constituents, a portion of alumina has been found. It is found in Wales, Bohemia, France, and Sweden. *Wood-stone* is a variety of this mineral. The specific gravity of this class varies from 2.50 to 3.10, and the minerals included are all infusible without addition before the blowpipe. Proceeding according to the chemical arrangement, the next in order is the class CALC SILICITE, including the minerals known by the name zeolite and its varieties—*silicious sinter* (*vide* Jamieson, v. i., p. 351, and my arrangement, 1835). This class is more numerous in elements, containing a large proportion of alumina, and in some cases potash in addition to the silex, though the lime is the characteristic ingredient, whence it derives its name, for though it occurs only in a small proportion, it is an ingredient in every variety in a greater or less degree. *Leuzite* is of a white or grey colour, occurring crystallised in igneous rocks, more particularly in the lavas of Vesuvius and Etna. *Analcime* contains 10 per cent. of natron in addition to the silex, alumina, and lime; its colour is white, of various shades, seldom occurring massive, but generally in crystals, the primitive form of which is the cube. It is found in the island of Skye in Scotland, in Perthshire, Bohemia, and in the Hartz. *Chabasite* approaches the foregoing variety in the proportion of its ingredients and general appearances. It occurs mostly crystallised, and the primitive form is the rhomboid. The localities are in the islands of Mull and Skye, at Oberstein, and in Greenland. *Cross-stone* derives its name from its form. In general it contains but little lime, though in varieties from Bilin in Bohemia, 2 per cent. have been detected on analysis with care, whereby it retains its place in the class which we are now examining. It accompanies the preceding varieties in all the localities in which they are found. *Laumonite* contains from 9 to 11 per cent. of lime, and is the accompanying mineral of all the other varieties. *Needle zeolite* is found in the cavities of the basaltic pillars of the Giant's Causeway and of Staffa, occurring massive and in distinct concretions (*mesotype* or common fibrous zeolite is another name for the massive needle zeolite). *Apophyllite* contains a very large proportion of lime, and according to the analysis of Vauquelin of a variety from Utoen, as much as 28½ per cent. It occurs most frequently massive, and not unfrequently crystallised, in Greenland, Bohemia, and Saxony. *Stilbite* is the radiated zeolite of Jamieson, and is nearly allied to apophyllite. *Silicious sinter* is the deposit of the silex contained in the water of the geysers, and is generally found stalactitic. Its specific gravity is little more than 1.5—it contains but little lime. The properties of this class are very decided, except in the last variety, with the exception of which, the average specific gravity is 2.30; they all occur in rocks of plutonic origin, and are all fusible with intumescence before the blowpipe.

FERRO SILICITE contains *lievrite*, *garnet*, and *cinnamon-stone*.

LIEVRITE (*yenite*, Haüy.)—It is of a brown or black colour, varying in intensity, and it occurs amorphous and crystallised. In composition it resembles garnet, with the exception of lime, which is the peculiarity of this mineral, whilst the proportion of iron is nearly the same as in the preceding class. This rare mineral has only been found in Corsica. Its name is derived from its discoverer, Le Lievre.

GARNET (*grenat*, Haüy; *granat*, Leonh.)—Comprises a great variety, which differ very materially in some points from one another. The garnet of jewellery (*almandine*) is of a beautiful reddish brown colour, sometimes having a tendency to become yellow. It occurs principally in primitive rocks, crystallised in the form of a rhomboidal dodecahedron, and less frequently granular. The most beautiful varieties are from Pegu, and others, though sometimes larger, but not so brilliant, are from the Alps, Bohemia, Italy, Brazil, and Ceylon. The *common garnet* differs but little from the precious, both of them occurring (crystallised) in the form of a rhomboidal dodecahedron, though the common garnet is more frequently granular, but it is softer than almandine, and is not employed for ornamental purposes on that account. It is a very abundant mineral, occurring principally in mica slate, gneiss, and sometimes in granite. In the mountains of Stiria they are met with upwards of two lbs. in weight (*vide* "Phillips' Mineralogy," p. 23). The name *pyrope* has frequently been given to common garnet, but it differs on account of the magnesia it contains. The following are varieties of garnet:—

Pyreneite.—Colour is greyish black, and it occurs crystallised. Before the blowpipe it loses its colour. Locality is the Pic of Eres Lids, in the French Pyrennees.

Grossulare.—Its colour is grass-green, and it likewise occurs crystallised in the form of the dodecahedron. It melts before the blowpipe. Locality is near the river Wilni, in Siberia.

Melanite.—Its colour is greyish black, or velvet black, and it occurs in roundish grains, and also crystallised in the common form of the garnet. Locality is Frescati, near Rome, and Monte Somma, near Naples.

Allochroite.—Its colours are greenish grey and yellowish grey. It changes colour before the blowpipe. Locality, Viuls iron mine, near Drammen, in Norway.

Collophonite.—Its colour is yellowish brown. It occurs massive, and crystallised in rhomboidal dodecahedrons. It is found at Arendahl, in Norway, and in Piedmont.

CINNAMON-STONE (*kanelstein*, Werner; *essonite*, Haüy).—Its colour is in general a bright red, passing into orange yellow. It occurs massive, of a shining appearance. Specific gravity is 3.61. It occurs in Ceylon, in granite rock, and in alluvial deposits. The average specific gravity is 2.50, and the per centage of iron varies from 13 to 45 per cent.

CALCALUMINO SILICITE (comprises *idocrase*, *prehnite*, *heulandite*, *Thomsonite*, *scolezite*, *Wernerite*, *epidote*, and *Indianite*).—The strong resemblance which exists in the chemical composition of the different minerals of this class, necessarily causes the physical mode of determination to be used to make a further distinction, and I shall therefore reserve the chemical description till I have completed the enumeration of the physical properties of each.

IDOCRASE (*Vesuvian*, Werner; *idocrase*, Haüy) is of yellowish or greenish colour, sometimes occurring massive, though more frequently crystallised. It possesses the property of double refraction. This mineral occurs principally in volcanic districts, particularly in the regions near Vesuvius and Etna, and it is likewise found in the primitive districts of the Alps and Siberia.

PREHNITE (*prehnite*, Werner and Haüy; *Prehn spath*, Mohs).—The origin of the name of this mineral may be attributed to the circumstance of its having been first brought from the Cape of Good Hope by Colonel Prehn. Its colour varies from yellowish to greenish white, and it is slightly translucent. Among the situations in which this mineral is found, that of Oisans, in Dauphiné, is perhaps one of the most interesting, on account of the various minerals with which it is combined. It is likewise found in Bohemia and in the Alps. In America fine specimens are obtained in Greenland.

Heulandite derives its name from its discoverer. It consists of the same earths as the preceding variety, and its colour varies from red to brownish grey, and it occurs in small quantities in Scotland and Dauphiné.

Thomsonite and *scolezite.*—Varities of the same class of minerals, similar to the preceding kinds in every respect except colour. The Thomsonite is of a brownish white hue, occurring radiated and fibrous; the scolezite in general very minutely crystallised or massive, and of a greenish white colour. The localities of these minerals are nearly the same as those of the last named.

Wernerite is a rare mineral, occurring of a greenish grey colour, imbedded in primitive rocks, and very rarely crystallised. It occurs principally at Arendahl, in Norway, in Sweden and Switzerland.

EPIDOTE (*pistacite,* W.; *thallite,* Karsten) is found in a variety of forms, principally massive, though often crystallised and granular; the colours are also various, occurring green, yellow, blue, or black, and it belongs exclusively to the primitive groups of rocks. It is a mineral found in great quantities in districts of all the above-mentioned formations in this country, in France, Transylvania, and in Guernsey. The localities in America are likewise numerous.

Zoisite, like many other minerals, derives its name from the person who first found it. The colours are shades of yellow and grey, and in composition it resembles all the varieties of this class. It is found in Carinthia, at Salzburg, and in the Tyrol. The general properties of this class are—a less degree of hardness than most of the minerals of the silicious class, melting before the blowpipe, and composition, on an average, 40 per cent. silex, 35 alumina, 20 lime, and iron or manganese the remainder.

Indianite.—This mineral is of rare occurrence; it is of a whitish or greyish colour, and of a shining lustre. It is translucent, and inferior but little in hardness to quartz. Bournon mentioned it as forming the gangue of Corundum, in the Carnatic (*vide* Phillips, p. 37).

FERRO CALC SILICITE (includes *axinite, lapis lazuli,* and *dipyre.*)

AXINITE (*Thumerstone,* J.; *axinit,* Leonh.)—The English name is derived from the form of the crystals, and Thumerstone is from its locality at Thum, in Saxony. It occurs crystallised, the primitive form being a right prism. Its colour is a fine brown, though some specimens, from containing a quantity of chlorite, are of an opaque green. It is by no means abundant, lining the cavities of primitive rocks in Saxony, in the Alps, in Norway, and in the Botallac mine, at Land's End, in Cornwall.

Lapis Lazuli (*lazurstein*, Leonh.; *azure stone*, T.)—This mineral, from which the ultramarine is extracted, is of a fine azure blue colour. It is principally found in the massive state, though mention has been made of crystallised lapis lazuli. It is found imbedded in primitive rocks, in which iron pyrites are disseminated. The finest specimens are from Persia.

Dipyre (*schmelzstein*, Werner) is a mineral of great rarity, occurring of a reddish white colour, and massive. It is found at Mauleon, in the western Pyrennees. It melts with intumescence before the blowpipe, and it contains but little iron.

Ferro-Alumino-Silicite (includes *tourmaline*).—Like some of the varieties of silicites, the colours of this class of minerals vary considerably, on which account I have reserved the descriptions of them till I mention the different sorts. All the varieties occur in prisms striated longitudinally, mostly in the primitive formations. Some are transparent, some translucent (blue is transparent, green translucent, pink and black are opaque). Frequently it is found in six-sided prisms, which possess the property of electricity. Specific gravity is 3.

Blue tourmaline of a transparent blue colour, occurring at Utoe in Sweden, and in the State of New York.

Green tourmaline is of a light grass-green colour, generally translucent, though often opaque—found at Ceylon and in Brazil; very fine specimens are found in the primitive rocks of the Alps; the colour is the result of the admixture of manganese.

Pink tourmaline is of an opaque pink colour, occurring in long striated prisms in primitive rocks. Very fine specimens are obtained in Bohemia.

Black tourmaline is the commonest of the varieties of tourmaline. It occurs principally in quartz rock in large crystals, or in veins traversing the same rock. It is also found in small crystals in the granite of Heidelberg, and it is frequent in Cornwall, Scotland, and Ireland. All these minerals melt into a pale glass before the blowpipe.

Hydro-Alumino-Silicite (includes *clay*, *slate*, and *fahlunite*).—This is another large division of minerals. As a general mode of distinction, these never occur crystallised, and belong to the secondary group of rocks.

Wacké occurs massive of a green, grey, or yellowish colour, and is somewhat greasy to the touch, yielding easily to the knife. It occurs in districts of volcanic origin.

Common clay occurs of a variety of colours, generally yellowish-grey, sometimes brownish-grey (London clay), of a soft appearance, and possessing when damp considerable tenacity, whilst some varieties when dry are exceedingly brittle. It is found in alluvial countries, on the banks of most rivers, and at the deltas of some few. Fossil remains, both of crustacea and plants, are frequent in the London clay. Above this formation rests the "loam," commonly known by the name of "brick earth." In appearance it is sandy, containing very few fossils.

Plastic or potter's clay derives its name from its tenacity. Its colour is generally greenish, and it is much employed in the fabrication of the commom varieties of pottery. Teignmouth in Devonshire yields considerable quantities.

Shale (*slate clay*, Phillips) occurs above the coal in the carboniferous districts of this and other countries. It occurs massive, and generally of a greyish-green and blue colour. It is abundant in the production of fossil plants, among which are several varieties of ferns.

Rotten-stone is of a brownish red colour, very soft, and contains according to the analysis of R. Phillips, 86 of alumina, 4 of silex, and 10 of carbon. It is believed to originate from the decomposition of shale, and is found in Derbyshire.

Tripoli has been found of various colours, generally of shades of grey, yellow, or red. It is of a very argillaceous appearance, and yields easily to the knife. It was originally brought from Tripoli, in Africa, but is now found in the department of Puy de Dome, in Saxony, and in Russia.

Polishing clay is another name of this mineral.

Lithomarge (*steinmark*, Werner; *argile lithomarge*, Haüy) is of a yellowish or reddish colour, frequently occurring spotted. It is soft, and adheres to the tongue. It is found in the porphyritic districts of Baden, and in Saxony.

Cimolite is of a grey colour, and generally occurs massive. It is found in the island of Cimola.

Bole is of a brownish, blackish, or blackish-white colour. It adheres to the tongue, yields to the nail, and when immersed in water it breaks to pieces. It occurs at the Giant's Causeway, in France, and in Silesia.

Mountain meal is so light as to swim in water. It is a rare mineral, and has only been found at Santa Tiora in Tuscany.

Pipe-clay is of a yellowish-white colour, and is known by a slight greasy feeling to the touch. It is found in the chalk district in the neighbourhood of Handfast Point, in Dorsetshire.

BARYTI-SILICITE (includes *harmatome, amianthoide.*)

Harmatome is nearly allied to cross-stone, but contains in addition to the constituent earth of the latter mineral a proportion of barytes, varying from 3 to 9 per cent. It accompanies most of the varieties of zeolite in the localities in which they are found. Its colour is yellowish or brownish-grey. It occurs rarely massive, more frequently however crystallised.

Amianthoide resembles asbestos, both in colour and appearance; like that mineral, its colour is greenish-grey, and it is also flexible. In a specimen from Oisans 6 per cent. of barytes has been detected.

MAGNESI-CALC-SILICITE (includes *augite, sahlite, fassaite, hornblende, pargasite, hedenbergite, and carinthin.)*

Augite is found generally in crystals, and forms an ingredient of several rocks; its form is an eight-sided prism, with diedral summits. The colour is in general brown or brownish-black, and exceedingly opaque. It is found in most of the volcanic regions, and also in Norway.

Sahlite is a variety of massive augite, and of much seldomer occurrence; it also occurs crystallised in the same form, and of a greenish-grey colour. Its name is derived from its locality, on account of being first found at the mine of Sahla, in Westmania.

Fassaite is a second variety of augite, though the colour differs materially, being a bright olive green. It derives its name from being found in the Fassa Thal, in the Tyrol.

Hornblende is of a brown or brownish-black colour, and resembles augite in appearance. It occurs massive, and disseminated in almost every rock. (In the granite of Bohemia, in many varieties of porphyry, and in syenite). It is also found of a slaty appearance, and is abundant in almost every country. The primitive form of its crystals is an oblique rhomboidal prism. It is plentiful in Scotland, in many parts of Germany, and in Mexico.

The next mineral of this class is *pargasite* (*pargasite*, Haüy and Leonhard), it occurs disseminated in plutonic rocks, in small crystals. Its colour is a light green, approaching to bluish green, and it is found at Pargas, in Finland, whence it derives its name. The rhomboidal prism is the primitive form of the crystals.

Hedenbergite occurs both massive and crystallised, and of a greyish green colour. It is a rare mineral, and occurs in the calcareous districts of Bohemia, accompanying the carbonate of lime.

Carinthin is another variety of this class, of a greyish green colour, and occurring massive, though frequently granular or crystallised. Its derives its name from its locality.

MAGNESI-SILICITE (includes *tremolite*, *schiller spar* and varieties, *anthophyllite, asbestos, kyanite, staurolite.*)

Tremolite (*grammatite*, Brong.) derives its name from Tremola, a valley in the Alps, where it was first found, though from some accounts it appears to have been first found in Transylvania. The varieties of this mineral differ only in outward appearance, the constituent parts being nearly the same in all cases. It occurs granular, fibrous, asbestous, common and glassy. Its colour is generally greyish-white, though it likewise occurs of a yellowish or greenish tint; it is shining and very brittle. It is found in limestone in the Highlands of Scotland, and the common variety is frequent in Transylvania, Italy, and France. It likewise occurs in basalt in the Castle rock, at Edinburgh. All the varieties lose their colour if subjected to a great heat. Its composition gives rise to the name of the class, and in addition to the above-mentioned earth, there is a considerable proportion of carbonic acid. The average specific gravity is 2.800.

Actynolite bears a strong resemblance to the above-mentioned variety, the distinguishing mark being generally the colour, which is green, of a variety of shades. It occurs fibrous, massive, and in elongated crystals. It occurs in Saxony, in Dauphiné, and Cornwall, and from the first-mentioned locality very fine specimens are obtained. It bears some resemblance to pipe schorl, from which, however, it is distinguished by its glassy appearance.

Schiller spar (*schiller spath*, Leonh.; *smaragdit*, Karsten) is of a blackish-green colour, passing into olive green, occurring both massive and in distinct concretions. It is softer than the next variety, from which it can be distinguished by its colour. It occurs in the Island of Skye and in other parts of Scotland, in Saxony, the Tyrol, and Cornwall.

Bronzite (*bronzit*, Leonh.; *blaettriger anthopyllite*, Werner; *argile metalloide*, Brong.)—Its colour is greyish yellow, and it also occurs of a brown shade. It is generally found massive. It has a semi-metallic appearance and lustre, and is difficultly frangible. It occurs with the preceding variety, in the Island of Skye, and in the Styrian Alps, and it derives its appellation from its appearance. Another variety denominated "hypersthene," or "Labrador schiller spar," is found in that peninsula with the felspar, and it likewise occurs in Greenland.

Anthophyllite (*anthophyllith*, Leonh.)—Its colour is yellowish grey or brown. It occurs massive, rarely crystallised, and has a shining lustre. In addition to the characteristic constituents, it contains oxide of manganese, iron, and alumina. It occurs principally in Norway, in primitive rocks.

Asbestos.—This class is characterised by its property of resisting heat and by its great flexibility, on which account it was employed for weaving cloths, which were used to collect the ashes of dead persons after they had been burnt; the value of the amianthus consisted in the length of the fibres, and it was woven with flax, which was afterwards burnt out. In Pliny's "Natural History," it is described as growing upon a plant in the most desert regions, and its duration when exposed to the fire is accounted for by its never receiving any nourishment in the situations where it is found.

Common asbestos (*gemeiner asbest*, Leonh.; *asbest dur*, Brong.) is either of a greyish or greenish-white colour. It occurs massive, in distinct concretions closely aggregated, and it rarely occurs crystallised (Bournon's Cat. Min., p. 123). It is less flexible than asbestos; it occurs in greenstone and metalliferous beds, in the Island of Skye, in Cornwall, in various parts of Europe, and more especially in the Saxon Erzgebirge.

Amianthus (*biegsamer asbest*, Leonh.; *asbest amianthe*, Brong.)—The shades of colour of this mineral are nearly the same as those of the preceding variety, though it has been found blood-red. It occurs in fibrous concretions closely aggregated, and is flexible. It is found in the western islands of Scotland, in Cornwall, in Saxony, and Bohemia, and in Dauphiné, in France, and considerable quantities are found in Italy. It also occurs in Asia and America.

Rock cork (*bergkork*, Leonh.; *asbeste suberiforme*, Brong.)—This mineral has received the different appellations of "mountain cork," "mountain leather," and "mountain paper," according to the various degrees of thickness in which it occurs. The mountain cork occurs in thick masses, filling the cavities of rocks; is rather tenacious, and swims on water. The mountain leather and mountain paper occur in plates, varying in thickness, in serpentine rocks. It occurs in Scotland, at Johanngeorgenstadt in Saxony, in Italy, France, and Norway. The specific gravity is about 2.410.

Kyanite or *cyanite* (*cyanit*, Leonh.; *disthene*, Brong.)—Its colour is a pale blue, though sometimes it occurs grey or green. It occurs massive, and rarely crystallised, and has a splendent lustre. Some crystals acquire negative electricity by rubbing, others positive. It is found in primitive mountains in Scotland, the Alps, Saxony, Bohemia, Spain, and the Tyrol. It occurs at Airolo on Mount St. Gothard, in a beautifully white mica slate. It has also been found in Asia and in America.

Staurolite (*staurotide*, Brong.; *grenatite*, Jamieson; *grenatit*, Werner).—It is of a reddish-brown colour, occurring only crystallised and opaque. It is found in primitive rocks, accompanying garnet in Scotland, in the Tyrol, in Spain, France, and the Alps, and in America. This mineral generally contains but little magnesia, though in the specimens from St. Gothard from 1.5 to 2.0 per cent. is found, which gives it its place in this class. The average specific gravity is 3.00, and all the minerals are difficultly fusible before the blowpipe.

POTASSI-SILICITE (includes *jade, obsidian, gabronite, petalite*). *Jade* (*saussurite*, Saussure; *jade de saussure*, Brong.)—Its colour is pea-green, passing into grey, occurring massive, and very hard. It is found in Italy, and recently in New Zealand.

Obsidian (*obsidian*, Leonh.; and *obsidienne*, Brong.)—Its colour is black, generally very intense, sometimes uniform, and at other times striped. It is found in Spain, in Ireland, in Siberia, and in the South Sea Island. It was used by the ancients for mirrors, and by the Spaniards, Mexicans, and Peruvians, it was used for knives, and Mr. Burkart describes the Serra de las Novajas, or mountain of knives, in his work on Mexico. It is a volcanic production, resembling glass. It has been long known, and is spoken of by Pliny under the name of "obsidius." The transparent varieties have received the name of "marekanite."

Gabronite (*arcticit*, Werner) is of a greyish-green or greenish-black colour; it occurs both massive and crystallised, though the former is the most common mode of occurrence, and it is very brittle. It occurs in the Saxon Erzgebirge, and is classed under the head of scapolite by Jamieson.

Petalite is of a greenish-grey colour, and like the preceding variety, occurs both massive and crystallised. It occurs in Saxony, Bohemia, and the Alps.

MAGNESITE.—This class of minerals derives its name from magnesia, being the characteristic ingredient, though, as in some other cases, it is not predominant. In its pure state this earth is of a white colour and earthy taste, with a specific gravity of 2.50.

HYDRO-MAGNESITE contains *hydrate of magnesia* (*reine talkerde*, Leonh.; *magnesite*, Brong.)—Its colour is yellowish-grey or white, it occurs massive, and it adheres to the tongue. From the analysis made by Bucholz it contains 48 per cent. of magnesia, and the rest is carbonic acid and water. It is found in Moravia in serpentine rocks, and in Italy.

Meerschaum (*meerschaum*, Leonh.; *écume de mer*, Brong.) is of a greyish-white colour, and occurs massive; it is soft, and adheres to the tongue. Specific gravity 1.723. It is found in Cornwall, in Moravia, and near Thebes, and also in Asia; in Turkey it is used for the manufacture of pipes, and in Spain it is employed in the manufacture of porcelain.

ALUMINO-MAGNESITE contains *pleonaste, iolite*. Both these minerals are rare.

Pleonaste (*pleonast*, Mohs.; *spinelle pleonast*, Brong.; *ceylanite*, Jamieson) is of a dark green colour, approaching black. It occurs in grains, and crystallised of an octahedral form. It was originally brought from Ceylon, and it is more or less met with in the different volcanic districts.

Iolite (*iolith*, Werner; *iölithe*, Häuy) is of various shades of dark blue, occurring both massive and disseminated, though rarely crystallised. Besides the characteristic constituents, it contains a large quantity of silica. It is found at Salzburg, at the Bay of San Petro, in Spain, and Mr. Heuland's collection contains several very fine specimens of the crystals of iolite from Greenland. It is used as a gem, though its brilliancy is not very great.

Silico-Magnesite.—*Chrysolite* (*chrysolith*, Leonh.; *peridot chrysolithe*, Brong.)—It is of an olive-green colour, translucent, and sometimes transparent. It occurs both crystallised and in grains, and the primitive form is a prism. In addition to magnesia and silica it contains from 10 to 19 per cent. of iron. It is found in the sand of rivers in the south of Europe, and is brought from the Levant and Upper Egypt.

Ferro-Magnesite.—*Olivine* (*olivin*, Leonh.; *peridot olivine*, Brong.) is of an olive-green colour, generally occurring disseminated or in grains, though sometimes massive and crystallised, which, however, is rarely the case. It likewise contains a large per centage of iron, and it is found in igneous rocks, accompanying augite. Its principal localities are the islands of western Scotland, Iceland, Saxony, Bohemia, Hungary, Italy, Spain, and France; in Africa, in the island of Bourbon, and in Greenland in America. It is difficultly distinguishable from chrysolite, though in general its colour is less intense.

Condrodite (*condrodit*, Leonh.) is of a yellowish or reddish-white colour, slightly translucent, and of lamellar structure. It occurs principally massive and rarely crystallised. It is found at Ersby in Finland, and it contains 22 per cent. of iron.

Calc-Silico-Magnesite contains the class of *serpentine* (*serpentin*, Leonh.; *serpentine*, Brong.) which is divided into two kinds, common and precious. They are both of a green colour, of different degrees of intensity, in which white veins are frequent. They only occur massive, and have a splintery fracture, and are difficultly frangible. They occur in beds of considerable size in various parts of Scotland and Cornwall, and in Europe, and are found in the Alps, in the Tyrol, and Saxony. When polished it is a very fine marble, and is much esteemed. The precious serpentine is, however, rare, and bears a much finer polish than the common variety, The specific gravity is 2.561, and they are both infusible before the blowpipe.

Hydro-Silico-Magnesite (contains *steatite* and *chlorite*.)

Steatite (*speckstein*, Leonh.; *steatite commune*, Brong.)—Its colour is white, passing into various shades of yellow, grey, brown, and reddish-white. It occurs massive and in six-sided prisms and rhomboids, and is soft, possessing a greasy feel, without adhering to the tongue. Its specific gravity is 2.671. It traverses serpentine in the form of small veins, and accompanies some of the metals in their situations. It is met with in Cornwall and Wales, and also in Scotland, and on the continent in all those countries in which serpentine is found. A very beautiful spotted variety is brought from China, where it is employed in manufacturing small figures and other ornaments. French chalk is a preparation of steatite, and is much used for marking on cloths, as the trace is very difficult to be removed, and it is employed as food by the savage tribes of Asia and America, who mix it with flour. The variety from China has received the name of "figure stone" or "agalmatolite" (*agalmatolit*, Leonh.), and it differs from steatite only in its colour, being somewhat of a darker shade.

CHLORITE (*chlorite*, Brong.; *chlorit*, Leonh.) has received a variety of additions to the name, denoting the state in which it occurs—thus the common chlorite occurs massive, the chlorite slate in beds, and "green earth," when it assumes a green colour and earthy appearance. It is frequently found enclosed in crystals of quartz and adularia, to both of which it imparts a green colour, and the colour of all the varieties is more or less green. The localities, too, are much the same; all the varieties occur in Scotland, in Saxony, in the Alps, particularly Mount St. Gothard, where it encrusts the axinite; and in France in Dauphiné. Some specimens contain iron, which, however, is absent in that brought from Dauphiné, so that it cannot be counted a constituent part. Its specific gravity is 2.612, and it melts into a black slag before the blowpipe.

YTTRITE comprehends only one known mineral, which is in itself extremely rare. The properties of the earth are not fully ascertained, though, like all the others, it is white in its native state.

GADOLINITE (*gadolinit*, Leonh., Brong., Haüy).—It is of a black colour, very intense, and sometimes flesh red. It occurs massive in prismatic concretions, and very rarely crystallised, its primitive form being an oblique four-sided prism. It is very brittle, and its specific gravity is 4.082. It contains 45 per cent. of yttria, besides a considerable portion of silica and cerium. It occurs at Finbo in Sweden, and at Ytterby in Roslagen; when exposed to the action of nitric acid it loses its colour, and forms a gelatinous material.

Aluminite is a very important class of earthly minerals, containing some of the most common minerals. When pure the earth is of a white colour, and heavier than silex. There is one mineral which bears the characteristic name of this class—viz.:

Aluminite (*reine thonerde*, Leonh.; *argil native*, Brong.)—Its colour is either white or yellowish-white, and it only occurs in small pieces, which absorb water, and slightly adhere to the tongue. Its composition is alumina 32.50, water 47.00, sulphuric acid 19.25, silica 0.45, lime 0.35, iron 0.45. (*Simon.* in Allgem Journ. der Chemie, 5 Jahrg. *S* 137.) It has hitherto been only observed in Germany near Halle, and at Newhaven in England.

Fluor-Aluminite (contains *topaz, kollyrite.*)

Topaz (*topaz*, Leonh., Brong.)—Its colour is yellow, passing from nearly white into very intense yellow. It occurs massive, though very seldom, but most frequently crystallised, of which the primitive form is an oblique prism. When exposed to heat topaz becomes white, but the Brazilian topaz on being similarly exposed becomes rose red. The topaz becomes electrical by friction, which property it retains for a considerable time. In addition to alumina and fluoric acid it contains silica. In Scotland it is obtained from Cairnghorm, and it is also obtained in Cornwall. In Bohemia and Saxony this mineral is also found, and also at Hirschberg in Silesia. It is found in Asia, in Ceylon, Pegu, Hindostan and Kamscatka, and in America it is found at Villa Rica, in Brazil. It is found in primitive rocks, either lining cavities, or aggregated with felspar, schorl, and quartz, whence it bears the name of "topaz rock." It has long been known, for mention is made of it in ancient history, when Cleopatra gave Anthony a very fine stone, and in several mineral cabinets of Europe are engraved specimens of this gem. It is much valued for ornamental purposes. The Cairinghorm quartz bears a strong resemblance, but it may be distinguished by its want of brilliancy, and its not becoming electric by rubbing.

Kollyrite is another variety of this class. Its colour is brownish yellow, inclining to straw-yellow, and it occurs massive and crystallised. It is found in Saxony and Siberia, and rarely in France.

Pycnite (*pyenite*, Brong.; *schoerlartiger berill*, Werner; *shorlite*, Kirwan).—Its colour is straw-yellow, and it occurs massive, and crystallised in hexahedral prisms, which become electric by rub bing. Its constituent parts are, alumina 51.00, silica 38.43, fluoric acid 8.84. (Berzelius.) It occurs at Altenberg in Saxony, at Slackenwald in Bohemia, and in Siberia. It is infusible before the blowpipe, but with borax melts into a white transparent glass.

POTASSI-SILICA-ALUMINITE embraces those minerals known by the name of *Mica*, (*mica*, Brong.; *glimmer*, Leonh.)—Their colours are in general greyish-yellow and greenish-grey, passing into brown of various shades. It occurs in a variety of forms, according to the different situations which it occupies. It generally occurs in a slaty form, when it occupies many of the highest situations in chains of mountains, and is itself a primitive rock, succeeding the granite, into which it also enters as a constituent part. The slate is either fine or coarse-grained, and varies in colour in different situations, but for the most part is greenish-grey. It frequently contains precious garnet and pyrope, which are sometimes of a very large size. It also occurs crystallised, and its primitive form is a rhomboid, the general figure, however, being an equi-angular six-sided table. Its lustre is semi-metallic, and it is flexible when it occurs in plates. Its specific gravity is 2.654, according to the analysis of Haüy. Its localities are too well known to need any description. It occurs in every country in which primitive rocks are met with, but the finest is from Siberia, where it is used for windows instead of glass. It is found on the banks of the Lena. Mica bears a strong resemblance to talc, from which, however, it can easily be distinguished by its greater brilliancy. Gold sand is merely a very fine variety of yellow mica with an extra metallic lustre.

Andalusite (*andalusit*, Brong.; *andalusit*, Leonh.) is of a flesh-red colour, occurring both massive and crystallised, in oblique four-sided prisms, and slightly translucent. It occurs entirely in primitive districts, accompanying felspar and quartz. Its composition is as follows: silica 32, alumina 52, potash 8, oxide of iron 2 (Vauquelin.) In England it occurs principally at Dartmoor in Devonshire, in Scotland in Aberdeenshire, and at Wicklow in Ireland. On the continent it is principally found in Andalusia, in Bavaria, and at Freyberg in Saxony.

Pinite (*pinit*, Brong.; *pinit*, Leonh.)—It is of a greenish colour, varying from olive-green to blackish-green. It occurs massive and crystallised, the general form of the crystal being an equiangular six-sided prism. It has a slight greasy feeling, and is soft. It is of rare occurrence in England, having been found only at St. Michael's Mount, but it is more plentiful in Saxony, Bavaria, and the Tyrol. Before the blowpipe it is infusible.

Bucholzite is a mineral very lately analysed, and its name is conferred upon it in honour of Buckolz, a celebrated chemist. It is but imperfectly known, the colour being a light brown, spotted sometimes with white, at other times with black. It was analysed by Dr. Brandes, who gives the following constituent parts: silex 46, alumina 50, potash 1.5, and oxide of iron 2.5. It was first observed in the Tyrol by Dr. Brandes.

POTASS-ALUMINITE contains *lepidolite, nacrite, lepidolite* (*lepidolith,* Brong. and Leonh.)—The name is of Greek origin, signifying a scaly stone. It is of a light flesh-red colour, occasionally grey, and sometimes purple. It is composed of a number of scales, having a semi-metallic lustre, and it is generally hard. In some, though not in every variety, lithia has been detected, but in general the characteristic ingredients are silica, alumina, and potash—of the latter of these there is about 9 per cent., which divides it from the preceding class. In addition to these there is also a trace of fluoric acid, manganese, and water. In primitive countries it is most abundant, occurring at Kradisko in Moravia in granite, and at Limoges in a vein of quartz; it also occurs in North America and in Scotland.

Nacrite (*erdiger talk,* Leonh.; *talc granuleux,* Haüy; *scaly talc,* Phillips.)—It occurs massive, in small scales, closely connected together, and with a slight pearly lustre. Its colour is green or greenish-white, and by this it is easily distinguished from lepidolite. It contains 17 per cent. of potash, with a small proportion of muriatic acid. It occurs at Freyberg in Saxony, and in Moravia and Bohemia.

HYDRO-POTASS-ALUMINITE (contains *Haüyne, Gieseckite, felspar, scapolite*); *Haüyne* (*Haüyn,* Karsten; *latialite,* Haüy).—It is of a pale-blue colour, passing into grey. Its most frequent form is granular, and when crystallised its figure is a rhombic dodecahedron. Its composition is—silex 30, alumina 15, sulphate of lime 20, lime 5, potash 11, oxide of iron 1, water 18. It occurs in the Basalt of Andernach, and at Albano in Italy.

Gieseckite is so named in honour of Sir C. Giesecké. It occurs crystallised in six-sided prisms, of a brown colour. Hitherto it has only been found at Akulliarasiarsuk in Greenland, whence it was brought by Sir C. Giesecké. (*vide* Phillips, p. 113.)

Felspar (*feldspath*, Leonh.; *feldspath*, Haüy), constitutes a class of minerals agreeing in a great many points with one another. Their chemical composition is always the same, and they all occur both massive and crystallised.

1. *Adularia* (*adular*, Leonh.; *feldspath nacré*, Brong.) is of a white colour, passing into greenish-white. The crystals are four-sided, surmounted by a pyramid of the same number of sides. When polished it is very splendent, and reflects light, from which circumstance it has received the name of "moon-stone." The analysis of Vauquelin gave the following result:—silex 64, alumina 20, lime 2, potash 9, water 5. It occurs in veins traversing granitic rocks, with quartz, and sometimes amianthus. It occurs at Snowdon in North Wales, and in the granite of Arran. The finest specimens are, however, obtained from Mount St. Gothard, which are of very considerable size.

2. *Common felspar* (*gemeiner felspath*, Leonh.) varies in colour from white to red, and into various shades of grey and green. It is generally opaque, at other times slightly translucent, and it occurs massive and crystallised in the form of an oblique four-sided prism, bevelled on both extremities. It contains only a slight portion of water, scarcely 5 per cent. It is a very abundant mineral, being a constituent part of granite and gneiss, and also forming in itself large and massive rocks. It also occurs in the form of veins traversing primitive mountains, and combined with hornblende, it forms syenite. It is the fundamental constituent of many varieties of porphyry. The localities are too numerous, and, indeed, are too well-known to require any enumeration, but the most beautiful crystals occur in the Alps, Siberia, and at Carlsbad in Bohemia.

3. *Labrador felspar* (*Labradorische feldspath*, Leonh.; *feldspath opalin*, Brong.)—Its colour is generally grey, but when exposed in certain directions to the light it displays a variety of colours. It never occurs crystallised, and its specific gravity is 2.692 according to Brisson. It was first brought from the Island of St. Paul on the coast of Labrador, but it is now found at Lauzwig, and Ingerrmannland in Norway, and in West Greenland.

4. *Icespar* occurs both massive and crystallised, in long six-sided tables. It is of a greyish-white colour, inclining to yellowish; it is

but imperfectly known, though from general characters it belongs to the felspathic class. It is very frangible. Its only locality is Monte Somma near Naples.

5. *Scapolite (scapolith,* Werner; also *arctizit*) occurs massive, either radiated, foliated, or compact, and crystallised in the form of an eight-sided prism. Its colour is red, of rather a pearly lustre, though sometimes dull. It occurs in the Saxon Erzgebirge, and at Arendahl in Norway, as well as in Sweden and Greenland.

6. *Elaolite* (*zeffstein,* Werner; *elaolitf,* Klaproth).—It occurs massive, of a blue colour, generally more or less approaching to green. It also occurs of a red colour, from the analysis of Klaproth, it is ascertained to be constituted of silica 46, alumina 30, potash 18, water 2, and also a slight admixture of iron and lime, together amounting to 2 per cent. It occurs at Lauzwig in Norway, and also at Itavern in the same kingdom. The average specific gravity of this class is 2.623.

CALC-SILICA-ALUMINITE contains *meoinite, sommite, chiastolite, sadalite, talc.*

Meoinite (meionite, Haüy) occurs in eight-sided prisms, terminated by tetrahedral pyramids, of a whitish colour, and shining lustre. It contains about .21 per cent. of lime. It occurs at Monte Somma, and also near Rome.

Sommite (*nephaline,* Haüy) occurs in grains or in small hexahedral prisms, of a greenish-grey colour, and vitreous lustre. When immersed in nitrous acid it gradually becomes cloudy internally, whence its name "nephaline." It occurs at Monte Somma, and also in the lava of the Cape di Bove near Rome.

Chiastolite (*chiastolith,* Leonh.) is of a greyish-white colour on the exterior, but black internally. It occurs in rectangular prisms, and also enters into the composition of the chiastolite slate. Its principal localities are at Wolfscrag near Keswick, and also in the county of Wicklow. On the continent it occurs in Gallicia, in Spain, and in the High Pyrennees.

Sadalite (*sadalith,* Leonh.) is of a light-green colour, massive, and crystallised in rhombic dodecahedrons. It is slightly translucent, and yields with difficulty to the knife. It is a rare mineral, having only been found in Greenland and Vesuvius.

Talc (*talc,* Leonh.; *talc,* Brong.) occurs massive, indurated, and in hexagonal crystals. It is composed of a number of plates connected more closely together than mica, and is consequently harder than that mineral. Talc generally occurs of a white colour, passing into yellowish or greenish, and is translucent. It contains but little lime. It is found at Glentilt in Scotland, and at Lizard Point in Cornwall. At Zillerthal in the Tyrol, and also at Salzburg. It was used in former times for polishing gypsum figures, and when pounded the Persians use it for their houses.

Corundum (*corund,* Leonh.; *corindin,* Haüy) occurs of a greyish, greenish, or red colour, generally translucent, but sometimes opaque and even transparent. It occurs crystallised in hexahedral prisms, and it also occurs granular and compact. It is plentiful in primitive rocks in India and China, and it has been found in Piedmont.

Ruby (*rubin,* Leonh.) derives its name from the Latin *ruber,* signifying red, which is its colour. It occurs crystallised in hexahedral prisms, and also in grains, in Ceylon and Pegu. In Europe it is found near Bilin in Bohemia, and at Expailly in France. It is also found at Mount St. Gothard. As a gem, it is highly prized on account of the extreme and rich depth of its colour, and its chatoyant lustre.

Sapphire (*sapphir,* Leonh.; *corindin telesie,* Brong.) occurs principally of a blue colour, passing into a green. It occurs in blunt-edged pieces and in grains, also crystallised in the form of an equiangular six-sided pyramid, with modifications, of which the primitive form is an acute rhomboid. It possesses the property of double refraction, and its specific gravity is 4.320. It occurs in Bohemia, Saxony, France, and Portugal, and in Ceylon and Persia.

Emery (*schmiergel,* Werner; *emeril,* Brong.) occurs of a blackish colour, massive, and of a fine-grained appearance. It is principally found in the East Indies, and it also occurs near Smyrna, in Saxony, and in Guernsey. It is used with water to polish minerals, and with oil to polish metals.

Automalite (*authomolit,* Werner; *spinelle zinciferè,* Haüy) is of a dark-green colour, and occurs crystallised in the form of an octahedron, and sometimes of a tetrahedron. It occurs in slate at Fahlun in Sweden.

Ceylanite (*ceylanit,* Werner; *spinelle pleonast,* Brong.) occurs of a green colour approaching black, in grains, and crystallised in the form of an octahedron. It occurs in Ceylon, in the sand of rivers near Monte Somma, and in the trap rocks of Andernach on the Rhine.

Salamstone (*salamstein,* Werner; *corindin hyalin,* Haüy) occurs of a reddish colour, passing on the one hand into bright red, on the other into brownish and bluish red. It occurs in grains, and crystallised in hexahedral prisms. It is translucent, and occurs only in Hindoostan. The name is the one by which it is known in the Indian Peninsula.

FERRO-POTASS-ALUMINITE *(schorl, killinite, rubellane, mellinite, spinellane, natrolite).*

Schorl (gemeiner schorl, Leonh.; *tourmaline opaque,* Haüy) occurs disseminated and crystallised in prisms deeply striated longitudinally. It is of a brownish-black colour, opaque, and shining, and passes into dark green. In composition the silica and alumina are generally nearly the same, both averaging about 34 per cent. Its name is derived from the circumstance of its being found at Shorlan in Saxony; but it also occurs in Cornwall, Argyleshire, Perthshire, Bohemia, Hungary, and Spain, principally in granitic, and always in primitic rocks. It occurs in beds, on which account it is easily distinguishable from tourmaline.

Killinite is found of a light green colour, occurring massive, and coated by a ferruginous covering, which yields an argillaceous odour when breathed upon. The characteristic constituents are alumina, potash, and iron, but the composition of this mineral is principally silicious. It occurs at Killiney in Ireland, whence its name.

Rubellane (rubellite, Phillips; *tourmaline rubellite,* Brong.) occurs of a brownish-red or red colour, passing into pink. It occurs crystallised in indistinct and aggregated masses, on which account it differs from red tourmaline. It occurs in Moravia, at Rozena, and also in Siberia. In America it occurs with green tourmaline in Massachusetts.

Mellinite occurs of a brownish-green or brownish-red colour, and opaque. It is found crystallised and massive, and is principally brought from Bohemia and Hungary.

Spinellane (nosin, Leonh.; *spinellane,* Haüy) occurs in crystalline masses, of a yellowish-blue colour, and of an hexahedral form. It has only been observed on the borders of the Lake of Leach, in felspathic rock.

Natrolite (natrolith, Leonh.) occurs of a pinkish or reddish brown colour, in mamillary masses, presenting a fibrous structure when broken. It occurs in the islands of Mull and Skye, and Rogan on Lake Constance, and at Bilin in Bohemia.

POTASSI-CALC-ALUMINITE (*clinkstone, pitchstone, lava, basalt, pumice*).

Clinkstone (klingstein, Leonh.; *pierre sonnante,* Brong.) occurs massive, of a yellowish-grey or greenish colour. Its name is derived from the ringing sound which it gives when struck by a hammer. It occurs in the Isle of Mull, and other parts of Scotland; in Bohemia, the Tyrol, and South America.

Pitchstone (pechstein, Leonh,; *petro silex resinite,* Haüy) occurs of a brown, grey, red, or black colour, massive, and of a slaty structure, possessing a vitreous appearance. It occurs in volcanic districts, associated with lava and pumice, and also in primitive rocks at Freyberg. It occurs in the trap-rocks of Mull and Skye in Scotland, and traverses granite at Newry in the county of Devon.

Lava bears the same name in both German and French. It is difficult fo describe the exact substance, for there are so many varieties that it must be with caution we should give a description of it. By lava, we generally understand that substance which is ejected in a liquid state from the craters of volcanoes, though many varieties bear no traces of the action of fire. Many varieties are also micaceous; some contain leuzite, and others have a fused metallic appearance. By these we generally understand "lava." It is of a brownish or greyish-green colour, porous, and brittle. It occurs principally in the neighbourhood of active volcanoes, though in many cases it is likewise found near those which have long since been inenergetic. It occurs in beds in Mexico, near the Rio Grande.

Basalt (basalt, Leonh.) occurs principally columnar, and also amorphous. It is of a brownish or greyish-black colour, of a granular texture, and opaque. It is very plentifully distributed, occurring in both the old and new worlds. The best examples are, perhaps, the Giant's Causeway in the county of Antrim, Ireland, and Staffa on the coast of Scotland. At both these places it occurs columnar, enclosing needle zeolite and mesotype.

Pumice (bimmstein, Leonh.) occurs of a greyish-brown colour, tinged with red, very porous, and light enough to swim on water. It occurs principally at the Lipari Islands, and but sparingly in the neighbourhoods of Vesuvius and Etna.

HYDR.-ALUMINITE is by no means an important class of mineral bodies, as it includes the single mineral known by the name of "Wavellite" (*wavelit*, Leonh. and Brong.; *hydr.-argyllite*, Sir Humphrey Davy).—It occurs botryoidal and globular, the internal structure being radiated. It also occurs crystallised, the most common form being a rhombic prism. Its colour varies from greyish to greenish, or brownish-white, semi-transparent, and externally shining. Its specific gravity is 2.270. When heated in mineral acids it effervesces, leaving very little residue. Its principal component parts are alumina 71.50, and water 28.0, though in other specimens traces of iron, lime, silica, and fluoric acid have been detected. It was discovered by Dr. Wavell, near Barnstaple, and since then it has also been found in Cornwall, and in Greenland, and Hualgayoc in South America. It occurs in a stalactitic form in Brazil.

7. CALCITE comprehends a useful, ornamental, and greatly diversified class of minerals, many of them highly esteemed. When pure the earth is of a white colour, but in this state it can only be obtained by chemical operations. Its specific gravity is 2.3. Berzelius examined this earth and found that it was composed of 28 per cent. of oxygen and 72 calcium; this latter is the metallic basis of chalk, but has not been observed accurately as it burns with great ardour when exposed to light. It was discovered by Sir Humphrey Davy, who gave it the name "Calcium."

Chalk (*kreide*, Leonh.; *chaux*, Brong.) approaches nearest to the chemical element, though it differs but little from the carboni-calcite or carbonate of lime. It is of a white or yellowish-white colour, and occurs massive, adhering to the tongue, and earthy in fracture. It is opaque, with a specific gravity of 2.3. It is one of the most recent secondary rocks, forming large tracts of country, easily distinguished by their smooth appearance. There are at least two layers of chalk, the uppermost containing, in all its situations, horizontal beds of flint, the latter generally abundant in marine productions—but organic remains are found in all the beds. There are a number of fossils characteristic of the chalk occurring in all the European cretaceous beds, but of the fossils of the American chalk only two have been identified with those of Europe. Annexed is a list of the fossils of the cretaceous system from Phillips's "Encyclopædia Brittanica" Supplement, p. 157.*

Polyparia	146	Varieties.
Radiaria	85	
Conchif. Plagrin	87	
——— Mesom	122	
——— Rudista	23	
——— Brach	67	
Gasteropoda	56	
Cephalopoda	107	
Crustacea	11	
Annulosa	30	
Cirropeda	2	

The countries in which chalk is principally found are Poland, France, and England. It also occurs in America and Egypt. It is much used in a variety of ways. In Western Norfolk it is used as a building material; when burnt, it forms lime, which is used for mortar and whiting; it is also used for polishing and for manure.

CARBONI-CALCITE includes all those minerals known by the name of "carbonate of lime" (*kalkspath*, Leonh.; *chaux carbonatée*, Bour.; *spath calcaire*, Brong.—The most perfect form of the carboni-calcite is the "double refracting spar." In this state it is nearly pure carbonate of lime. The crystallised form of this spar is the rhomboid, and the colour is white, or yellowish-white. It is principally brought from Iceland, whence its name "Iceland spar." Calcareous spar is not so hard as fluor, on which account it is easily distinguishable from that mineral. Carbonate of lime also occurs crystallised in a variety of forms, upwards of 500 different crystallisations having been observed, and most of them figured in the "Traité de Mineralogie par le Comte de Bournon." The most common variety is the dog's tooth spar, which occurs very beautifully aggregated at Clifton, in the calcareous rocks on which that town stands. The primary form is the obtuse rhomboid, and the varieties are generally modifications of this figure (Bournon has described fifty-six modifications of this figure, which has greatly been added to by other mineralogists). When laminated it passes into *schiefer spar* (*schiefer spath*, Leonh.; *chaux carbonatée nacrée*, Haüy).—Its colour is white passing into reddish or green. It occurs in Saxony, in Cornwall, in Dauphinè, and in Perthshire in Scotland.

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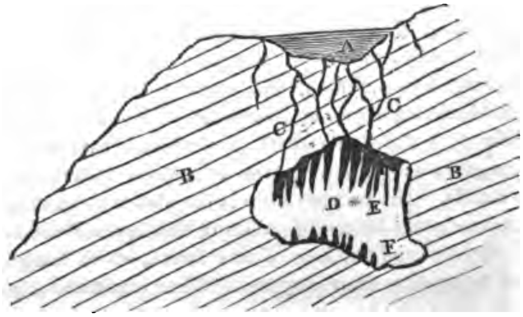
* For Fossils of Western Norfolk, from cretaceous group, *vide Mining Review*, No. 5.

Satin spar (chaux carbonatée fibreuse, Haüy) is so named from its satin-like appearance. It occurs of a whitish-grey colour, at Alston Moor, and is much used on account of the high polish it takes for ornamental purposes.

Agaric mineral (*rock milk,* Jamieson) is a rare and beautiful mineral, of a pure white colour, meagre to the touch, earthy, and very light, so much so, that it will float for some time on water. It effervesces violently in acids, leaving but a little sediment. It occurs in the crevices of calcareous rocks in Switzerland and in England; it occurs at Sunderland, and near Chipping Norton in Oxfordshire.

Stalactitic limestone occurs mammilated, forming long pendulous masses. The colour varies, though in general it is yellowish-white. The principal localities are—the Woodman's cave in the Harz mountains, Auxelle in France, in Derbyshire, and in the grotto of Antiparos. The formation of these singular productions is not well understood, for the variety of forms in which it occurs renders it a matter somewhat dubious in its nature. The principal, however, is sufficiently evident, for a successive filtration through the earth of a water of a calcareous nature is sufficient to leave a deposit of considerable size, if continually exposed. The annexed wood-cut will elucidate the subject better than explanations.



A is a pool of water resting upon a calcareous rock B, through which it penetrates into a cavern in the same rock by means of the fissures CC. By continually acting upon the chalk, it carries particles with it, which are deposited upon the roof of the cavern, and the water still passing through the rock adds gradually to the length, till it will sustain no greater weight, when the overplus falls on to the ground, and in the same manner forms stalagmites, as represented by F in the figure.

Common limestone (*dichter kalkstein,* Leonh.; *chaux carbonatée compacte,* Haüy; *secondary limestone,* Phillips) is of a granular appearance, approaching earthy. It occurs of a variety of colours, generally, however, of shades of brown, red, and black. It is a rock of much importance, and spreads into considerable districts, in which veins of metal occur, generally of sulphuret of mercury, lead, and zinc. Several limestones are very fine-grained, and bear a high polish, on which account they are much valued as marbles. The beautiful white variety from Carrara is the most valuable, and is much used in sculpture. The varieties are exceedingly numerous, and derive their names either from their locality or their appearance.

Oolite (*roogenstein,* Werner; *roestone,* Jamieson) is another variety of limestone, found massive, and in large beds; it increases its hardness upon exposure. It is common in many parts of England, particularly near Bath, and on the continent it is also found. It abounds in fossils. Its name is derived from the small granular texture it possesses.

Peastone (*erbsenstein,* Leonh.; *chaux carbonatée concretionnée globuli-forme testacée,* Haüy) has also received the appellation of "pisolite." It is generally of a white colour, approaching somewhat to brown, and the grains vary in size. It is brittle and soft. It occurs at Carlsbad in Bohemia, where it is formed by the rotatory motion of the water rising from the cretaceous bed, and the same reason is perceptible in the water of the baths of St. Philips in Tuscany.

Madreporite (*lucullite,* Jamieson; *madreporite,* Broag.) occurs in roundish masses, indistinctly lamellar, and somewhat curved. It is opaque and of a greyish colour. It occurs at Stavern in Norway, at Salzburg, and in Greenland.

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When substances are exposed to the action of water containing particles of cretaceous matter in solution, they become coated in a longer or shorter space of time with a covering of cretaceous matter, white in appearance, except when iron enters into the composition, when they assumes a reddish-brown colour. The time which is required for the completion of the process varies according to the nature of the spring which contains the chalk. That of Carlsbad requires a week to form a slight covering, whilst that of Tivoli performs the same in two days. Through the kindness of Professor Leonhard, I was favoured with the sight of some entire bunches of grapes which had been exposed to the action of the waters of the latter place, and the globular form was perfectly preserved; on breaking one of the globules, however, there was merely a hollow, in which was a shrivelled remnant of the grape, proving thereby that the process must have taken place rapidly. I have likewise in my possession specimens of Tufa (this is the name given to the *petrefactions*) (*versteinerungen*), in which the moss still remains green.

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Another process, equally interesting, is that of the formation of the *calc sinter* (*kalk sinter*, Leonh.)—The best example of which I am aware, is in a Roman arched drain near Cologne. The deposit is striated, not always horizontally, but sometimes also curved, and of yellow and brown colour. The bottom of the drain is covered with a coating of this horizontal calc sinter, and towards the surface it is more curved, proving that the water was agitated at the time of the deposition of the uppermost layers. This marble receives a high polish, and is employed for the altarpieces of many churches in Germany. These three different processes, by which minerals are continually being formed, cannot fail to be interesting, as they show that minor changes are continually going on imperceptibly.

STRONTI-CALCITE contains *arragonite* (*arragonite*, Haüy; *arragonit*, Leonh.)—It occurs massive, radiated, and crystallised in the form of a six-sided prism, with the lateral facets marked by a longitudinal crevice. The crystals are transparent, and of a yellowish or whitish colour. It derives its name from its having first been observed at Arragon in Spain; it also occurs at the Dufton lead mines near Ilfracombe, in Durham, at Salzburg, and at Marienberg in Saxony. According to the analysis of the Rev. J. Holme, it consists of carbonic acid, lime, and water; but from another analysis it is constituted of lime 94.5, carbonate of strontian 3.9, iron 0.7, water 0.3 (Stromeyer's analysis of a specimen from Arragon)

MAGNESI-CALCITE contains *bitter spar, pearl spar, brown spar,* and *dolomite.*

Bitter spar (*bitter spath,* Leonh.; *chaux carbonatée magnesifère primitive,* Haüy) is commonly found crystallised in the form of an obtuse rhomboid. The colour is greenish-grey or yellow. It is distinguishable from calcareous spar only by analysis, which proves its composition to be carbonate of lime 68, magnesia 25.50, alumina 2, iron 1, and water 2. It occurs at Loch Lomond in Scotland, and also in the Isle of Man. It is also found in Sweden, the Tyrol, and North America.

Pearl spar (*spathiger braunkalk,* Leonh.; *chaux carbonatée ferro-magnesifère,* Haüy) is classed by Jameison under the name of brown spar, from which, however, it differs materially in colour. Pearl spar occurs massive and crystallised in obtuse rhomboids, with a pearly lustre, and of a white or yellow colour. In addition to the characteristic ingredients, it contains a large proportion of carbonic acid, and a trace of iron and manganese. It is soluble with slight effervescence in muriatic acid. Its localities are in Derbyshire, Devonshire, and Cornwall, and with sulphuret of zinc in Durham.

Brown spar has been described by Phillips as a carbonate of iron, from which, however, it is easily distinguished by its composition. It occurs in the same form, and under the same circumstances as the preceding mineral, but it is not so abundant. It is of a reddish-brown colour, with a slight pearly lustre; like the preceding variety also, it effervesces slightly in acids. Its composition is as follows:—lime 43, magnesia 10, iron 8, manganese 3, and water 26. It accompanies calcareous spar, heavy spar, fluor, galena, iron pyrites, and silver; and it is principally found in Cumberland and Derbyshire, and on the continent in Norway, Sweden, France, Saxony, and Hungary.

Dolomite (dolomit, Leonh.; *chaux carbonatée magnesiferè,* Haüy) occurs of a whitish colour, both massive, granular, flexible, and columnar. It is soft, yielding to the nail. Its composition is 40 carbonate of magnesia, and 59 carbonate of lime. It is found in France, Saxony, Sweden, and Spain. Its name was given in honour of Dolomieu. It resembles granular limestone, but it effervesces very feebly in acids, which distinguishes it.

Magnesian limestone (brown dolomite, Tennant) is of a yellowish colour, and occurs massive, with a granular texture. It is composed of lime, magnesia, and a large per centage of carbonic acid. In the north of England it occurs in beds of considerable thickness, and it likewise occurs in Durham, Northumberland, and Derbyshire.

PHOSPHORI-CALCITE contains the mineral known by the name of *apatite (apatit*, Leonh.; *chaux phosphatée*, Haüy), which occurs crystallised in six-sided prisms, terminated by a six-sided pyramid. It is of a white, yellow, green, or red colour, sometimes all occurring in the same crystal. It is composed of lime 54.28, phosphoric acid 45.72. It occurs in the granite of St. Michael's Mount, and also near St. Agnes in Cornwall. It likewise occurs in Bohemia and Saxony with tin.

Phosphorite (*phosphorit*, Leonh.) is the name given to the massive variety of this mineral.

FLUORI-CALCITE includes a very important, though simple class of minerals, from which the powerful acid called "fluorine," which has such an affinity for silex, and consequently for glass, is obtained. It occurs massive and crystallised in a variety of forms, of which the primitive and most common is the cube. The crystallisations being important I will give a list:—

1. The cube.
2. The cube truncated on all the edges.
3. The cube with truncated angles.
4. The rhomboidal dodecahedron.
5. The octohedron.
6. The octohedron with the solid angles replaced by square planes.

The octohedron is, however, a very rare form of this mineral. The colour of it is also various, as it occurs both blue, green, purple, yellow, white, brown, and rarely, however, light red, approaching lilac. The specimens of the cube fluor, truncated both on the sides and angles, are rare, more particularly the former, which gives the specimen the appearance of being marked round the squares of the cube with a white line. The crystals of all the varieties are generally aggregated, and the specific gravity is 3.0943 according to Haüy. Before the blowpipe it melts into a white glass, losing all its colour. If sulphuric acid is added to the fluor-spar, when pounded and heated, a very penetrating and offensive vapour is produced, which bears the name of "fluorine," the properties of which I have already mentioned. It forms large beds in some countries, and in others it occurs in veins, aggregated with carbonate of lime, spathose-iron, quartz, and blende It is very plentiful in Durham, traversing veins of sulphuret of lead. It likewise occurs in Derbyshire, and associated with tin and copper in Cornwall, but it is rare in Scotland. On the continent it is abundant in Saxony, the Harz mountains, Norway, and sometimes in Italy, and it is common in America. Its name is derived from the mineral being used when pounded as a flux for metals; and it is employed in Derbyshire for the manufacture of ornamental vases, &c. Its resemblance with calcareous spar, though deceiving in some cases, is easily detected, for it does not effervesce, as calcareous spar, in acids.

Sulphuri-Calcite includes *anhydrite, vulpinite,* and *gypsum.*

Anhydrite (*vulpinit,* Leonh.) occurs massive, crystallised, granular, and fibrous, of a whitish, greyish, or bluish colour. It occurs at Hallein, the Tyrol, and in Carinthia and Austria. Its composition is lime 40, and sulphuric acid 60, though in some varieties a trace of muriate of soda has been detected, when it is called *muriacite* (*cube spar,* Jameison; *wurfelspath,* Leonh.)

Vulpinite (*siliciferous anhydrous gypsum,* Phillips) is found in laminated concretions, of a whitish colour Its composition is sulphate of lime 92, and silex 8. It occurs at Vulpino in Italy.

Gypsum (*gyps,* Leonh.; *chaux sulphatée,* Haüy) occurs fibrous, compact, and earthy. It occurs of a whitish or reddish colour, and sometimes yellow. It is slightly translucent. It occurs principally in the chalk formation of Paris, and it likewise occurs in Switzerland and Bavaria. In England it occurs in Derbyshire, Devonshire, and Yorkshire.

There is also a crystallised variety which bears the name of *selenite* (*chaux sulphatée crystallizée,* Haüy). The form is an oblique parallelopiped. The colour is the same as that of gypsum. It occurs at Alston in Cumberland, and in Oxfordshire. It is also found in the London clay, and in Bohemia and Siberia.

Nitro-Calcite includes *nitrate of lime* and *dathalite.*

Nitrate of lime (*chaux nitratée,* Haüy) occurs efflorescing, and sometimes pulverulent. It is soluble in water, and is found on old walls and calcareous rocks, and it is very bitter. Its composition is lime 32, nitric acid 57.44, and water 10.56.

Intermediate between this and the next class stands the mineral known by the name *dathalite* (*datholit,* Leonh.; *chaux boratée sili-*

cieuse, Haüy), which occurs of a greenish or greyish colour, and is slightly translucent. It occurs massive and crystallised in the form of a rhombic prism, with the edges and angles replaced by planes. It contains as well as nitric acid a portion of boracic acid. It has been found at Arendahl in Norway.

Bora-Magnesi-Calcite contains the mineral known by the name of *boracite* (*borazit*, Leonh.; *magnesie boratée*, Haüy).—It occurs crystallised in the form of a cube, with the edges replaced, and the diagonally opposed solid angles differently modified. It is of a whitish or greenish colour, and is composed of lime, boracic acid, and magnesia. It occurs at Kalkberg in Brunswick, and also in Holstein.

Barytes, the characteristic earth of the next class, is of a white colour, with a caustic taste. It consists of 90 per cent. of a metallic base termed "barium," and 10 of oxygen. It has never been found pure, but always in combination with either carbonic or sulphuric acid, forming minerals, which can easily be detected by their great weight. Barytes is a violent poison.

Carboni-Baryte is the name given to those minerals in which barytes is combined with carbonic acid. It includes only one mineral, known by the name of *witherite* (*witherit*, Leonh.; *baryte carbonatée*, Haüy).—It occurs massive, crystallised in the form of an hexhahedral prism, terminated by six-sided pyramids, and also stalactitic. It is of a whitish, greenish, or yellowish colour, slightly translucent at times, but more frequently opaque. From analyses of specimens from Stiria its composition is barytes 78, and carbonic acid 22. It was discovered by Dr. Withering, after whom it was named, in Lancashire; and it also occurs in Shropshire, near St. Asaph in Flintshire, and in Stiria and Salzburg.

Sulphuri-Baryte is barytes in combination with sulphuric acid, and from its weight this class has received the name of *heavy spar* (*schiver spath*, Leonh.; *baryte sulphatée crystallisée*, Haüy).—It occurs both massive and crystallised. The primary form is a right prism, with rhombic bases. Its constituent parts are barytes 67, and sulphuric acid 33. The principal localities where this mineral is obtained are in Cornwall, at Alston Moor, and near Babbicombe Bay in Devon. It occurs at Schriesheim near Heidelberg. When fibrous it is called "Bolognian stone," from its occurring near Bologne. By German mineralogists it is termed "Bologneser spath."

STRONTIAN, the characteristic earth of the next class, occurs white. It is composed of 16 per cent. of oxygen, and 84 of strontian—a metal which was first noticed by Sir Humphrey Davy.

CARBONI-STRONTITE includes the mineral known by the name of *strontianite* (*strontian* Leonh.; *strontian carbonatée*, Haüy).—It occurs massive and crystallised, of which the primitive form is the right rhombic prism. It is composed of strontian 70, and carbonic acid 30. Its name is derived from the place where it was first observed, namely, at Strontian in Scotland; it also occurs in Saxony.

Sulphuri-strontite is the chemical name for *celestine* (*celestin*, Leonh.; *strontiane sulphatée*, Haüy) it occurs of a white or yellowish-white colour. The primitive form of the crystal is the same as the preceding variety. It also occurs stellated. Its localities are the south-westerly portion of England, more particularly Devonshire and Somersetshire. It also occurs in Yorkshire and Westmoreland, and on the continent at Montmartre. It likewise occurs with sulphur in Sicily.

There now remains but a few of the earthy minerals, which from their composition cannot be classed under any particular head. These are the alkaline minerals, one or two of which are but imperfectly known, and which consequently cannot have any place assigned to them in the chemical classification.

ALUMINO-POTASSITE (*alum*, Phillips; *alaun*, Leonh.; *alumine sulfatée alkaline*, Haüy) occurs principally as an efflorescence on argillaceous minerals. It occurs in slate, and forms stalactites, of a whitish or pinkish-white colour. Its composition is sulphuric acid 76, alumina 12, and potash 3. It occurs in England near Whitby, and also in Scotland; and it is likewise found in Norway, Bohemia, and Hungary.

NITRA-POTASSITE (*nitre*, Phillips; *naturlischer salpeter*, Leonh.; *potasse nitratée*, Haüy) occurs in crusts of a whitish or yellowish-white colour. It occurs on old walls, or chalk, situated in damp places. It can also be produced artificially by exposing animal refuse to the action of the atmosphere, by which means azote is disengaged and combines with the oxygen, forming nitric acid; and this again combines with the potass in the vegetable matter, and forms nitre. It is the principal constituent part of gunpowder, the sulphur being employed on account of the facility with which it burns, and the charcoal on account of its readily igniting, for the principal object in the manufacture which has to be observed, is so to surround the nitre with inflammable substances that it may readily take light, and disengage the greatest possible quantity of gas in as short a time as possible.

CARBO-SADALITE (*natron*, Phillips; *mineral alkali*, Leonh.; *soude carbonatée*, Haüy) occurs massive, radiated, efflorescing, and in the form of crusts. It is of a grey or yellowish-white colour, and it has a very saline taste. It occurs in the waters of some hot springs, more particularly in that of Carlsbad, and also in lakes which are dried up in summer, in Hungary and Egypt. The natron appears efflorescing on the soil, and when gathered reappears in a few days. It is almost always combined with *sulphuri-sadalite* (*sulphate of soda or glauber salt*), which resembles it in colour and general appearance.

BORO-SADALITE (*borax*, Phillips; *soude boratée*, Haüy) occurs in prismatic crystals, of a translucent white, blue, or green colour. It occurs principally in Thibet, and in its rough state is called "tincal."

MURIO-SADALITE (*common salt*, Phillips; *gemeiner steinsalz*, Leonh.) occurs in beds, and also crystallised in the form of a cube. It has a shining lustre, and when pure is perfectly white and transparent; but when combined with clay it becomes brown, grey, red, blue, and green. It is a very abundant mineral, occurring in large beds, and in the waters of springs and lakes. It is an ingredient in the waters of the ocean. It occurs principally at Northwich in Cheshire, Droitwich in Worcestershire, and on the continent in Savoy, Germany, Spain, and Russia.

Salammoniac, or muriate of ammonia, is by no means a plentiful mineral. It occurs principally in crusts, though likewise in crystals. Its colour is grey, green, or brownish black. It is insoluble in water, and may be reckoned among the productions of recent volcanic regions. It also occurs in Tuscany, Germany, and Persia, and it is said to occur in the northern coal-field of England. It has not been carefully analysed, but it is composed principally of ammonia and soda.

Pollyhallite generally occurs fibrous, of a brick-red colour, seldomer compact, of a transparent white. It is difficultly fusible before the blowpipe, but tinges borax brown. It has not been analysed with accuracy. It occurs at Ansen in Steyermark with rock salt, and also in Upper Austria.

CLASS II.—METALS.

By *native metals* we understand all those metallic bodies which occur pure in their native state, though there are but few of them; the rest are denominated according to their composition, either *sulphurets* (when sulphur enters into combination with the native metal), *oxides* (when the metal combines with oxygen), or *arseniates* (when combined with arsenic), and so forth. The systems of metallic mineralogy have, taken as a whole, been better managed than the earthy minerals, for we find in a greater or less degree that they have received a chemical nomenclature, with the exception of a few, which have retained the same appellations from their localities or discoverers.

In this division of the treatise I shall, therefore, endeavour to show the importance which must be attached to the greater number of them, and where space will permit, I shall endeavour to give the method in which they are purified, thus endeavouring to combine simple metallurgy and metallurgical processes with the study of metallic mineralogy.

The order in which they are arranged deviates perhaps from many other systems, but their relative value, not in the pecuniary point of view, but in their use or scarcity, has induced me to follow Jamieson's system of order in this case, and at all times the uses of the metals perhaps form the best systematic arrangement.

PLATINA (*platin*, Leonh.; *platin natif ferrifère*, Haüy) is one of the rarest metals, and being the hardest, is consequently used in all cases where extreme nicety is required; and by opticians it is much used in instruments, either mathematical or astronomical, for those parts on which scales of measurement are marked, or which are exposed to great heat. It is of a steel-grey or silver-white colour, occurring in very small grains, which are rarely large, and is nearly as hard as iron, being malleable and ductile, with a specific gravity of 15.601, Tralles; 17.7, Wollaston; and when purified, 23.0. It is infusible except before the oxygen blowpipe, and is soluble in nitro muriatic acid. Till very lately it was only found in South America, and there only in Brasil, Peru, and Rio del Pinto. Lately, however, it has been found of a much larger size in the Ural mountains, between Russia and Siberia. It occurs only in small quantities, associated in the sand of rivers or alluvial districts with grains of gold, magnetic iron, and zircon. It is much used for crucibles in chemistry, and also for reflecting mirrors. It is also employed in porcelain painting, in the place of silver, as it does not tarnish so easily as silver, and is of nearly the same colour. In Russia it is coined, the smallest coinage being of the value of 16s. 8d., or thereabout.

Palladium (*palladium*, Wollaston), like the preceding metal, occurs of a silver-white or steel-grey colour, and likewise in small grains, but may easily be distinguished from it by its smaller specific gravity, which is only from 11.0 to 12.1 And it is likewise easily detected by its solubility in nitric acid, to which it imparts a deep red colour. It is likewise infusible, except when mixed with sulphur, when it readily melts. It occurs in the same localities as platina, and is perhaps preferable to that metal in the manufacture of delicate instruments, except when required for a very great heat.

Iridium and **Osmium** are always found associated with one another, in small grains of a steel-grey colour. Its specific gravity is 19.1, and when fused with nitre it acquires a dull black colour, but recovers its original lustre and colour by heating with charcoal. It occurs with platina in the alluvial soil of South America, and was first noticed by Wollaston. It is exceedingly rare.

Gold (*gold*, Leonh.; *or natif*, Brong.) occurs of a bright yellow colour, inclining to brass yellow, and greyish yellow. It occurs granular, capillary, and crystallised in hexahedrons and octohedrons. It is shining externally with a metallic lustre, very malleable, and its specific gravity is 17.6 to 19.2. It generally contains a small portion of silver or copper. It occurs in primitive rocks, rarely in sandstone, and also in the alluvial sands of rivers. It has been found in small quantities in various parts of England, Scotland, and Ireland, but there are no mines in this country which are worked for gold alone. On the continent of Europe the oldest known locality is Pesterana in the Alps, where it occurs minutely disseminated in sulphuret of iron. It is also found at Gardette in France, in Upper Hungary, and in granite at Salzburg, and in Spain. In Asia it occurs in Thrace and Macedonia, in Siberia, Java, Japan, Formosa, Borneo, and Sumatra. In Africa it is principally obtained by washing the sands of rivers in the neighbourhood of Zahara, the Gambia, Senegal, and Niger, and is collected and brought to market in quills. In the New World it occurs principally in Peru and Mexico, in primitive rocks. The principal portion of the Mexican gold is obtained in the province of Oaxaca, and the mines of Rio San Antonio are much famed for their produce. The following are the most remarkable pieces of gold:—From Paraguay 50 lbs. weight; La Paz, in Peru, 45 lbs. ditto; Choco 25 lbs. ditto. In North Carolina it occurs in granitic rock, and also in the state of Virginia in quartz. The ancients denominated gold in combination with silver *electrum*, which, from Klaproth's analysis, averages gold 64, and silver 36 per cent. It occurs in the sand of the Rhine, at Schlangenberg in Siberia, and at Wicklow in Ireland.

SILVER is a metal of much value on account of the incapability of tarnishing easily, and its rarity. It has been known from the earliest times, and used for ornamental purposes, such as the manufacture of vases, &c., and for the coinage of different countries, for which purpose it was first used by the Greeks. The following are the forms in which it occurs :—

1. *Antimonial silver* (*spiesglanz silber*, Leonh.; *argent antimonial*, Brong.) occurs of a white metallic colour, disseminated, massive, and crystallised in the rectangular four-sided prisms, longitudinally streaked; its specific gravity is 9.4, Haüy. It contains 11 per cent. of antimony, though in some specimens 24 per cent. has been detected. Before the blowpipe the antimony is volatized with its usual odour, and leaves a mass of pure silver. It occurs in the Andreasberg mine in the Harz, in Spain, Suabia, and France.

2. *Molybdic silver* (*molybdaen silber*, Leonh.) is of a steel-grey colour, occurring crystallised in hexahedral prisms, of a metallic appearance. Before the blowpipe it melts into small globules, of a yellow colour, and somewhat tarnished. It occurs at Pilsen in Hungary.

3. *Sulphuret of silver* (*glanzerz*, Leonh.; *argent sulphuré*, Brong.; *silver glance*, Jamieson) occurs of a dull grey colour, of a metallic appearance, which, when exposed to the atmosphere, becomes covered with a steel-coloured tarnish. It occurs massive principally, and sometimes crystallised in the following forms, viz.—the cube, the octahedron, and rhomboidal dodecahedron. When exposed to the action of fire the sulphur is evaporated, and a bead of pure silver remains. Its constituent parts are silver and sulphur, the latter entering into its composition in the various proportions of 15, 16, and 25. Its specific gravity is 5.8. It is the most plentiful of the ores of silver, occurring in veins traversing primitive and secondary rocks, but principally in gneiss and granite. It is generally associated with lead and copper, and in combination with gold it forms the metal known by the name of *electrum*. It occurs with lead in the mines of Cornwall and Devonshire. In the Harz mountains, at Schemnitz in Hungary, Joachimsthal in Bohemia, and Schlangenberg in Siberia. It is frequent in Mexico, more particularly in the mines of Guanaxuato, Zacatecas, and Halpujahua. It is extracted from the ore by the process of amalgamation with mercury. The red variety (*rothgültigerz*, Leonh.) is so named on account of its colour.

4. *Bismuthic silver* (*wismuth silberez*, Leonh.) occurs of a lead-grey colour, disseminated and crystallised. It is easily distinguished from sulphuret of silver by the metallic globules which ooze out when exposed to the flame of an oxygen blowpipe. It contains the following proportions of metallic elements:—bismuth 27, lead 33, silver 15, iron 4.30, copper 0.90, and sulphur 16.30. It has only been found in the Black Forest, in a vein traversing gneiss.

5. *Carbonate of silver* (*kohlensaures silber*, Leonh.; *argent carbonaté*, Haüy) occurs of a greyish-black colour, massive, and glistening. It effervesces in nitrous acid. It contains about 12 per cent. of carbonic acid, and 15.5 of antimony, the remainder consisting of silver. It occurs at Altwolfach in the Black Forest in primitive rock, accompanied by sulphuret of silver, and native silver.

6. *Muriate of silver* (*silber hornerz*, Leonh.; *argent muriaté*, Brong.; *hornerz*, Werner) occurs of a greenish, brownish, or reddish-blue colour; massive, investing, and crystallised in cubes, slightly translucent, and sectile. It is fusible in the flame of a candle, and when exposed to the heat of a flame urged on by a blowpipe,

it melts into a metallic globule, and emits the same vapours as muriatic acid. It occurs in primitive rocks, in veins in which other ores of silver and lead are found, in Huel Mexico mine in Cornwall, and also in Saxony, the Harz mountains, France, and Siberia. It occurs also in Peru.

Mercury is the only metal which occurs liquid in its native state, and its ores are by no means numerous. In combination with sulphur it forms the sulphuret of mercury, and it is also met with in combination with silver and silex. It is thirteen times heavier than water.

Native fluid mercury (*gediegen quicksilber*, Leonh.; *mercure natif*, Brong.) is of a silver-white colour, and occurs in small globules, in the crevices of rocks, particularly in those in which the sulphuret of mercury is found. It is found at Idria in Saxony, in Bavaria, and in Spain, and is employed for the process of amalgamation on account of the property it possesses of volatilising at a lower temperature than red heat.

Sulphuret of mercury (*cinnabar*, Phillips; *zinnober*, Leonh.; *mercure sulphuré*, Haüy) occurs of various shades of red, passing from vermillion to carmine. It occurs most frequently massive, rarely crystallised, in acute rhomboids. According to the analysis of Klaproth, it consists of 84.50 quicksilver, and 14.75 sulphur. It occurs in the sandstone and shale formations, rarely in the clay slate, and is generally accompanied by the native quicksilver. It occurs in the same localities as the preceding variety. When combined with bitumen the colour is more dull, and this variety is then known by the name of *bituminous cinnabar*.

Copper is the next metallic element which deserves our attention, as it occurs very plentifully in nature, and enters into the composition of other minerals. In its native state it is tenacious and malleable, and eight times heavier than water. It is a very useful metal, forming several alloys, viz.:—

Copper + zinc = brass.
10 copper + 2 tin = bell metal.
2 copper + 1 tin = speculum.

It occurs principally in primitive countries (all the Cornish mines are situate in this description of country, with the exception of a few, which are in the argillaceous schistus).

Copper occurs in the native state (*gediegen kupfer*, Leonh.; *cuivre natif*, Brong.) in a variety of forms, either in rolled pieces, in sheets, dendritic or massive. It is of a copper-red yellow, incrusted in many cases with green. It has been found crystallised in the form of a cube and modifications of the same figure, but they are generally very minute and imperfect. It is flexible, though not elastic, malleable, and difficultly frangible. Specific gravity 8.4. Native copper is composed almost entirely of copper, generally with a small proportion of gold or iron, and it is the only metal which occurs plentifully in the native state. The rocks which contain veins of this metal are generally primitive; sometimes, however, it is found in the older secondary rocks, as greywacke and granular limestone. It is found in Cornwall, in Norway, and at Fahlun in Sweden; in the Saxon Ergebirge, Oberstein, Salzburg, and near Lyons in France; near the Coppermine River in North America, and at the foot of the volcano of Zurullo in Mexico. One of the largest masses known weighs 2600 lbs., and was found in Brazil.

Ferrate of copper (*grey copper*, Phillips; *fahlerz*, Leonh.; *cuivre gris*, Haüy) is of a steel-grey colour. It occurs massive, and crystallised in the form of a tetrahedron. It is composed of copper 52, iron 23, and sulphur 14. It also occurs with a proportion of arsenic (arsenical ferrate of copper), and antimony (antimonial ferrate of copper), and rarely with a small portion of platina. It occurs in the same localities as native copper, and is accompanied by the various ores of copper, but is less frequent in Cornwall than the other varieties.

Sulphuret of copper (*copper pyrites*, Jamieson; *yellow copper*, Jamieson; *kupferkies*, Leonh.; *cuivre pyriteux*, Brong.) occurs of various shades of yellow, crystallised in tetrahedrons, with the solid angles replaced. It also occurs botryoidal and amorphous, and often beautifully variegated. It can easily be distinguished from iron pyrites by its yielding to the knife, which iron pyrites does not. It always contains a large proportion of iron and sulphur; it is separated from the latter by roasting, and the residue is boiled in nitric acid, from which the iron is discharged by the addition of ammonia. It is the most abundant of all the ores of copper, accompanying not only the other ores of the same metal, but likewise those of lead, iron, and nickel. Very fine specimens are obtained from the Tincroft mine in Cornwall. When arsenic enters into the composition (*arsenical sulphuret of copper*) the colour changes into a yellowish white, which easily tarnishes. Before the blowpipe it emits white arsenical vapours, by which it can be easily distinguished from copper pyrites. It has been found at Huel Gorland in Cornwall. The greatest proportion of the copper which is manufactured in England is from this ore. The annual produce of the copper mines of England alone is estimated at 80,000 tons of ore, or 7000 tons of pure metal, which averages 90*l.* per ton.

Oxide of copper (red oxide of copper, Phillips; *rothkupferer*, Leonh.; *cuivre oxidé*, Brong.) occurs of various shades of red. It is transparent or translucent, occurring in octahedral crystals, generally minute, and with a specific gravity of 4.9. It occurs in several of the mines of Cornwall, and the Hartz, and also in Norway, Sweden, and South America. The constituent parts are copper 88, and oxygen 12. Before the blowpipe it is easily reducible to a metallic globule.

Carbonate of copper (malachit, Leonh.; *cuivre carbonaté*, Brong.; *malachite*, Phillips) is a very important division of the ores of copper. There are three varieties—the green, blue, and crysocolla. The first occurs of various shades of green, fibrous, and sometimes stellated. Before the blowpipe, upon borax, it is reducible to the metallic state, and gives a green colour to the borax. The average proportion of carbonic acid is 19 per cent. It occurs with all the other varieties of copper, in all their localities, but the finest specimens are from Siberia. It is susceptible of a very high polish, and is used on that account for ornamental purposes.

Chrysocolla (*kupfergruen*, Leonh.) is the name given to that variety which, in addition to the carbonic acid, contains silica and water. It is of a bright green colour, occurring botryoidal, massive and stalactitic. It accompanies the carbonates, and is found in Bohemia, Siberia, and Cornwall. It occurs also in Mexico.

Hydro-carbonate of copper (*blue carbonate of copper*, Phillips; *kupferlazur*, Leonh.; *azure cuivre*, Brong.) occurs of a dark blue colour, crystallised and botryoidal. It accompanies the green carbonate, and is found in Chili, Bohemia, France, and Saxony. Fine specimens are obtained from Huel Unity mine in Cornwall.

Sulphate of copper (blue vitriol, Phillips) is of a blue colour, and occurs massive, stalactitic and botryoidal. It consists of copper

33, sulphuric acid 30, and water 27. It occurs in Cornwall, and plentifully in the mines of Saxony; it also occurs in Cuba, and in Mexico. Sulphate of copper can be prepared artificially, but then forms into crystals, in which state it is rarely found in nature.

Phosphate of copper (*phosphor kupfer*, Leonh.; *cuivre phosphaté*, Brong.) generally occurs crystallised, of a blackish-green colour, generally translucent. In some cases it occurs of a yellowish-green colour, and crystallised in prisms, which are reducible to an octahedron. From the analysis of Klaproth, it consists of copper 68.13, and phosphoric acid 30.95. It is found near the river Tamar in Cornwall, at Rheinbreitbach, and in Hungary.

Arseniate of copper (*arsenikkies*, Leonh.; *cuivre arseniaté*, Haüy) occurs of a variety of forms, of which I add an enumeration, viz.:—

I. Octahedral....	bluish white	translucent
II. Rhomboidal ..	green	opaque, except when small
III. Trihedral	bluish black	opaque
IV. Prismatic	brownish or yellowish-green..	translucent

The two first varieties are not so hard as fluor; the two last, however, are harder. The composition of the varieties differs but little—in general, copper, arsenic acid, and water—the first composing one-half, and the second one-fifth per cent., enter into the composition. They are all found in Cornwall, principally in the Huel Unity and Trincroft mines.

* * * * *

The ores of copper can always be distinguished from those of iron, by the blue colour they afford when immersed into liquid ammonia.

A very important class of metallic bodies next comes under our inspection, containing several very interesting combinations and crystallised specimens of metals. As a metal, iron cannot be too highly esteemed, nor its value fully appreciated, as it not only enters into the composition of almost every substance, but it forms the principal article in the manufactures, and consequently in commerce. England knows how to appreciate its value better than any other nation, for, in the manufacturing districts, the increase of power and superiority of workmanship are merely the results of the successful application of steam power to machinery, and these are all of iron. Iron is magnetic, and it acquires this property when it is merely placed in a vertical position for some hours, the northern pole being always at the lower extremity. The ores of iron are numerous, as will hereafter be seen. It is found in combination with oxygen, sulphur, the phosphoric, muriatic, carbonic, and sulphuric acids, silex, alumina, and water, and when pure has a specific gravity of 7.8.

It seems from general accounts and actual remarks, that the different ores of iron belong to different tracts of country, or different formations, as, for example—the oxides and carbonates, or brown iron ores, belong to primitive tracts, the red iron to secondary districts, and those in which alumina enters into the composition to carboniferous tracts of country, either resting upon the coal or forming layers in the clay slate between the beds. Iron is very tenacious and malleable, and more ductile than gold and silver. It occurs in nearly a pure state, though this is rarely the case, and it is then reported to have fallen from the atmosphere. In this state it is of a steel-grey colour, and is composed of iron and a small portion of nickel. It is a very rare mineral, occurring generally in the warmer countries, only one instance being known of its being found in England; it is, however, reported to have been found in Ireland. A mass weighing 3000 lbs. was formed near the Red River, in Louisiana, and a large mass is preserved as a corner-stone in one of the towns of Northern Mexico. It has been found in several localities in South America, and in Siberia.

Sulphuret of iron (*schwefelkies* Leonh.; *iron pyrites*,* Phill.; *fer sulphuré*, Brong.) is the most abundant mineral of the class, being the one from which the iron of commerce is in a great degree extracted, but if not carefully smelted it is likely to be brittle, and consequently of less value. It occurs in rounded masses, and crystallised in the form of the cube or octahedron, and modifications of them. It likewise occurs as a coating to other substances. Its colour is brass yellow, sometimes brownish, owing to decomposition, as the sulphur is readily disengaged in a short space of time, particularly in the rounded masses, and the mass then falls to pieces. That from the Alps, which is the matrix of the gold, contains so much sulphur that it destroys the paper upon which it is placed. From the analysis of a specimen from Bognor, it is constituted of iron 45, and sulphur 55; but this varies according to circumstances. It contains frequently a proportion of arsenic, which causes the colour to be more of a grey, or a portion of gold, then it assumes a deep yellow colour. In this class the gold pyrites of the Alps is placed. It has been conjectured that the rounded masses are of atmospheric origin, on account of their form and the quantity in which they are found. A short time ago a mass of chalk which had been thrown out into spoil, after forming an embankment on the London and Birmingham Railway, was found covered the next morning with small masses of sulphuret of iron, agreeing precisely in description with this class, and which had no doubt fallen during the preceding night. It is also singular that these masses are found in or near chalk districts only.

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* Pyrites is derived from the Greek, in allusion to its giving sparks when struck.

Aluminate of iron (*strahlkies*, Leonh.; *fer sulphuré blanc*, Haüy; *white iron pyrites*, Phillips), is of a metallic tin-white colour, sometimes slightly tinged with yellow. It occurs botryoidal, stalactitic, and crystallised. It derives its name from the small proportion of alumina it contains, but which rarely exceeds 3 per cent.; on analyzing a specimen with care, I have detected 3 per cent. of alumina, 48 of iron, 49 sulphur, and the form of the crystal, which deviates but slightly from the varieties of sulphuret of iron, may be attributed to this addition. It occurs plentifully in Cornwall.

Magnetic sulphuret of iron (*magneteisen*, Leonh.; *fer sulphuré ferrifère*, Haüy) occurs massive, and crystallised in six-sided prisms, of which the lateral angles are replaced by planes. It is found of a yellowish-white, reddish or brownish colour, at Moel Elion, in Caernarvonshire, in Norway, the Harz mountains, and Silesia. When pure it is magnetic. A second variety has received a different appellation (*magnetic iron ore*, Phillips; *magneteisenstein*, Leonh.) on account of the much smaller proportion of iron it contains. It occurs crystallised in octahedrons, which is the primary form, and of a metallic, shining, black colour. It also occurs massive (*loadstone*), but not so frequently. It is a plentiful associate of iron pyrites in schistous rock, and is plentiful in primitive rocks. In Cornwall it is associated with other ores of iron, and is frequent in the schistous formation of Mexico.

Oxide of iron (*oxydeisen*, Leonh.) occurs massive, of various shades of red, of an earthy appearance and texture, and yields a somewhat clayey odour when breathed upon. It is constituted of iron and oxygen, in the proportion of 13 of the former, to 38 of the latter. It is found plentifully in Wales, Cornwall, Bohemia, and Siberia, associating the ores of iron and copper, and not less frequently accompanied by quartz.

Oligistic iron (*eisenglanz*, Leonh.; *fer oligiste*, Brong.) differs from the magnetic sulphuret of iron by its not possessing the magnetic power. It occurs lamelliform, and rarely crystallised. It is of a shining iron-black colour, brilliant, and often irridescent. It is most plentiful in Elba; less so in Bohemia, Bavaria, and Saxony, and uncommon in North America. From the analysis of Hassenfratz, it is composed of 69 iron, and 31 oxygen.

Hydrate of iron (*rothereisenstein*, Werner; *red iron ore*, Phillips) is likewise known by the name of *hematite*, and occurs fibrous, massive, and scaly, of a red colour, varying in intensity. Some varieties occur of a grey colour; specific gravity 4.7. It is well calculated for the manufacture of iron, and occurs in primitive rocks in Devonshire, Cumberland, Bohemia, Saxony, and Silesia.

Hydrosilicate of iron (*brauneisenstein*, Leonh.; *fer oxydé*, Haüy; *brown iron ore*, Phillips) occurs of various shades of brown, and crystallised, also in botryoidal and stalactitic masses. From the analysis of Vauquelin, it has been ascertained to consist of iron 80.25, water 15, silex 3.75, on which account I have named it hydrosilicate of iron. It occurs in secondary rocks, principally in Saxony and Bohemia, also in the Tincroft mine in Cornwall. It affords a very good iron for the steel manufacture, on account of the absence of any acid.

Silicate of iron (*jaspisartiger eisenstein*, Leonh.; *jaspery iron*, Phillips) occurs of a yellowish or reddish-brown colour, and massive. It occurs at Neustadt, in Austria, in limestone, and in Shropshire. It is very hard.

Carbonate of iron (*spathose iron*, Jamieson and Phillips; *fer spathique*, Brong.; *spatheisen*, Leonh.) occurs of various shades of yellow, passing into light brown, with a lamellar structure, and shining. The analysis of a specimen from Cornwall yielded, iron 62, carbonic acid 37, magnesia 1. It differs from brown spar in composition and colour, and from hydrosilicate of iron in composition likewise. It occurs in several of the Cornish mines, but not plentifully; in the Harz, and North and South America.

Phosphate of iron (*blue iron ore*, Phillips) occurs of a bluish-green or blue colour, of an earthy appearance, and crystallised in right oblique-angled prisms. It contains about 30 per cent. of water. It occurs with iron pyrites in the neighbourhood of St. Agnes in Cornwall, and in Bohemia. A second variety, which partakes still more of the earthy appearance of the foregoing species, is found in the peat bogs of the different parts of this country; it is, however, distinguishable on account of its grey colour, which on exposure becomes blue.

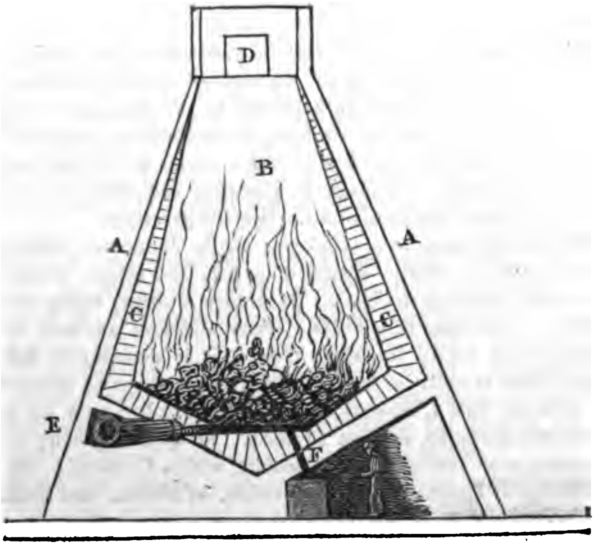
Sulphate of iron (*green iron*, Phillips; *eisenvitriol*, Leonh.) occurs of various shades of green, yellow, and yellowish-green. These latter colours are, however, the result of exposure, the natural colour being a bright emerald green. It occurs principally massive, but is also found crystallised in right oblique-angled prisms. It is an associate of the different ores of iron, and occurs with them, and in the coal-mines of northern England. It arises from the gradual decomposition of iron pyrites, which I have mentioned in that article.

Chromate of iron (*chromeisenstein*, Leonh.; *fer chromaté*, Brong.) occurs of a black or yellowish-black colour, rarely yellow. It is found massive and crystallised, in octahedrons; also disseminated. It occurs in serpentine rocks in the United States of America, and also in Cornwall. It is employed as a pigment, and produces a fine yellow colour.

Arseniate of iron (*wurfelerz*, Leonh.; *cube ore*, Jamieson; *fer arseniaté*, Haüy) occurs of various shades of green, reddish-brown, and brownish-yellow. It occurs principally in cubes, seldomer massive, with a vitreous lustre. It is sometimes transparent, though not unfrequently opaque. From analysis it has been ascertained to consist of iron 48, arsenic acid 18, water of crystallisation 32, carbonate of lime 2.50. It becomes electric when exposed to heat. It occurs in the Wheal Unity mines; also in the department of Haut Vienne in France.

Oxalate of iron (*Humboldtine*) has only recently been discovered; but from all accounts it appears to be of a bright yellow colour, and occurs in indeterminate crystals, with a specific gravity of 1.3. The analysis of Mariano de Rivero determines its composition to be iron 54.56, oxalic acid 46.14. It occurs near Bilin in Bohemia, and also at Kolowserieu.

Having completed the description of the ores of iron, I will now turn my attention to the mode of extracting the metal. The blast-furnace is at once the most efficient and the quickest. Annexed is a representation of the blast-furnace, upon the most simple and approved principle.



DESCRIPTION OF THE DIAGRAM.

A A The outer form of the furnace, consisting of a pyramidal brick building, surmounted by a square summit.

B The interior, of a similar form, declining towards the bottom, to allow the metal to flow freely downwards.

C C A surface of fire brick, on that part exposed to the action fo the heat.

D A small hole, through which the furnace is fed, and the ore added.

E A pipe, conveying a stream of forced air into the lower portion of the combustible matter in the furnace.

F A small pipe, by which the molten metal is allowed to run off into the receiver *g*, which is either formed for making the "pig" iron, or ornamental purposes. The object of performing the operation in this manner, is to drive off the arsenical and sulphur particles which are contained in the ore, and to decompose the matrix in which it is found.

MANGANESE, the metal next in succession, has rarely been reduced to the metallic state, on account of the readiness with which it is decomposed on exposure to the atmosphere. It is employed in the glass manufacture, for producing a violet colour, and is used, when in the state of black oxide, to produce oxygen gas. It is found principally in primitive countries, but is also present in secondary formations. Specific gravity 8.

Silicate of manganese, (*siliferous oxyde,* Jamieson; *manganese oxydé silicifère,* Haüy) occurs of a pale red colour, sometimes yellowish, inclining to black. It occurs massive, rarely crystallised in curvilinear rhomboids. From different analyses, which have yielded nearly the same results, it is determined that its composition is nearly in the following proportion—viz., manganese 49, silex 49, lime 4, magnesia 1.6. It melts into a pale red glass before the blowpipe, without addition. Its specific gravity is 3.2. It occurs near Tavistock in Devonshire, and in Cornwall. On the Continent at Laughaushylta in Sweden, in Siberia, and Transylvania.

Oxide of manganese (*grau braunsteinerz,* Werner; *manganese oxidé,* Brong.) occurs of a steel-grey colour, crystallised in prisms, the primary form of which is a right rhombic prism. It is soft, and very brittle. There is also a compact variety, which bears the name of *wad,* when possessing an earthy appearance. It occurs plentifully in iron-mines, and is likewise found near Callington in Cornwall, near Bristol, and at Aberdeen. The earthy variety is an ingredient in the peat of the morass, near Capper in Ireland.

Sulphuret of manganese is of a brownish-black colour, and occurs botryoidal and massive. Its composition is, manganese 82, sulphur 11, and carbonic acid 5. It is found in Cornwall and Transylvania.

Carbonate of manganese (*manganese oxydé carbonaté*, Haüy) occurs massive, and of a grey colour, more commonly, however, rose-red. It occurs in Bohemia.

Carbonisilicate of manganese (*hornmangan*, Leonh.) is a mineral, of which, but little is comparatively known. The following is the description of a specimen which I obtained through the medium of Professor Leonhard. It occurs massive, in globular efflorescences or druses, varying in size, forming the surface of silicate of manganese and brown iron ore. It is somewhat brittle, and of a dark brownish-grey colour, approaching steel-grey. From analysis, it consists of manganese 54, silex 32, carbonic acid 8.2, and water 3.4. It occurs at Stahlberg, with jaspery iron ore.

Allagite contains the same constituents, and a trace of lime; it occurs in the Harz.

Rhodonite contains a portion of alumina, and the photogite contains a larger per centage of carbonic acid than the preceding minerals.

ARSENIC rarely occurs in the metallic state in nature, but the metal is of a bluish-white colour, and of a metallic brilliancy. It is a very plentiful constituent in almost every variety of metallic production, and constitutes a class of ores in itself. It occurs in primitive countries, and its specific gravity is 8.31. Its poisonous qualities are well known, and need no further remark. It is plentiful in most primitive rocks, and can always be detected, by the offensive odour which it yields when exposed to heat.

Sulphuret of arsenic (*realgar*, Phillips; *realger*, Leonh.) occurs of a beautiful red (*realgar*) or yellow colour (*orpiment*), both varieties occurring crystallised, massive, disseminated, acicular, and investing; but it is by no means abundant in any one of these forms. The crystals are prismatic, and are either translucent or slightly transparent, becoming electric by rubbing. The results of two analyses by Klaproth, are as under:—

	Realgar.	Orpiment.
Arsenic	69.0	62.0
Sulphur	31.0	38.0
	100.0	100.0

The specific gravity of both being 3.3 to 3.4. It occurs in primitive rocks in the provinces of Dauphiné in France, in Gallicia and Transylvania, at Andreasberg in the Harz, and in Mexico and China, and generally associated (viz., realgar and orpiment).

Oxide of arsenic (*arsenicbloom*, Jamieson; *arsenikbluethe*, Leonh.; *arsenic oxydé*, Haüy) occurs of a snow-white colour, with a slight tinge of yellow, red, or grey, generally of an earthy appearance, though it likewise occurs capillary and investing It accompanies the red sulphuret of arsenic at Andreasberg, at Joachimsthale, and in the province of Dauphiné.

Native arsenic (*gediegen arsenik*, Leonh.; *arsenic natif*, Haüy) though so called, differs materially from other native metals, on account of the numerous foreign ingredients it contains, among which may be enumerated, copper, silver, gold, and iron. It is of a greyish-black colour, brilliant when first broken, but when exposed to the air it becomes dull; it occurs massive, botryoidal, and sometimes nearly fibrous. It occurs in the province of Alsace in France, at Konigsberg in Norway, and at numerous other parts of Germany and the American continent.

Bismuth is of a reddish-white colour, very brittle, and easily fusible—(from experiments made by Sir Isaac Newton, an alloy of 8 parts of bismuth, 5 of lead, and 3 of tin, melts in water below he boiling point). It is fo und pure, and also with sulphur. It is used in several soft solders; specific gravity 9.8.

Gediegen wismuth, Leonh.; *bismuth natif*, Haüy).—It has generally a slight external tarnish, and it occurs principally amorphous, with a lamellar structure. Before the blowpipe it volatilizes in the form of a white vapour, with an arsenical odour. It occurs in primitive districts of country, associated with cobalt, nickel, silver, and lead; at Johanngeorgenstadt in Saxony, in France, Transylvania, Norway, and Cornwall.

Sulphuret of bismuth (*wismuthglanz*, Leonh.; *bismuth sulphuré*, Haüy) occurs of a lead-grey colour; crystallised in prisms deeply striated longitudinally, and in small masses. Its specific gravity is 6.1. It occurs at Joachimsthale and Georgenstadt with native bismuth, cobalt, and arsenic. It frequently contains copper (*cupriferous sulphuret of bismuth*, *vide* Phillips, p. 274), when the metal becomes tarnished of a red colour. The analysis of Klaproth determined the composition to be, bismuth 47.24, copper 34.66, and sulphur 12.58. It likewise occurs in combination with lead (*plumbo cupriferous sulphuret of bismuth, vide* Phillips, p. 274), of a steel-grey colour, with a yellowish tarnish. The annexed is the analysis of John, bismuth 43.2, lead 24.3, copper 12.1, nickel 1.5, tellurium 1.3, and sulphur 11.5. The only known locality is near Beresof in Catharinenberg in Siberia.

Carbonate of bismuth is a rare, and as yet but imperfectly known mineral. It occurs of a yellowish or whitish colour, somewhat earthy in appearance, but harder than carbonate of lime. It occurs in Cornwall, at St. Agnes and St. Columb.

ANTIMONY is found in primitive and secondary districts, of a silvery-white colour, brittle, and of a specific gravity of 6.5 It is employed in medicine, and in the composition of printing types.

Native antimony (*gediegenspies-glas,* Leonh.; *antimonie natif,* Brong.) is of a tin-white colour, which becomes tarnished by exposure. It occurs amorphous, with a lamellar structure, easily frangible, and containing 97 per cent. of antimony, and the remainder a mixture of silver and sulphur. It occurs in Dauphiné, in the Harz, and at Sahlberg in Sweden.

Sulphuret of antimony (*grey antimony,* Phillips; *grau spiesglaserz,* Leonh.; *antimonie sulphuré,* Haüy) occurs of a light metallic-grey colour, massive, and crystallised in rhombic prisms, which are laterally aggregated. A fine variety is found on the north coast of Cornwall, near St. Agnes, very compact and closely radiated. It likewise occurs in Auvergne, the Harz mountains, and in Hungary. A very beautiful variety, from Huel Boys mine in Cornwall, has received the name of *plumose sulphuret of antimony,* on account of its downy appearance. It occurs investing the surface of other metals and minerals. Another variety is known by the name of *red antimony* (*antimonie oxydé sulphuré,* Haüy); it is slightly translucent, and very brittle, and is composed of antimony 67.5, oxygen 10.8, sulphur 19.7. It occurs, with all the other varieties, at Allemont in France.

Oxide of antimony (*weiss spies-glaserz,* Leonh.; *antimonie oxydé,* Haüy) occurs of a greyish-white or yellowish-white colour, in tabular crystals, but more commonly massive. It is translucent, soft, and heavy, with a shining lustre. It accompanies the other ores of antimony at all the localities where they are found, and at Malazka in Hungary, in clay containing sulphuret of antimony.

Earthy oxide of antimony (*antimonial ochre,* Phillips) occurs of various shades of yellow and brown; it occurs investing the ores of antimony, and is brittle and earthy in appearance. It is found in Cornwall with the ores of antimony.

Molybdena has never been found pure, and is difficultly reducible to the metallic state, when it is of a greyish-white colour. It is a rare mineral; its specific gravity is 8.6.

Sulphuret of molybdena (*wasserblei*, Werner; *molybdaen*, Leonh.) is of a bright lead-colour, and it occurs massive, and in flat hexahedral tables, opaque, and slightly flexible. It consists of molybdena 60, and sulphur 40. It is soluble with violent effervescence in carbonate of soda. It occurs in Cornwall, at Calstock, in Huel Unity, and Huel Gorland; also in Westmoreland, and in Glenelg in Invernessshire.

Oxide of molybdena (*molybdaenocke* Leonh.) occurs of various shades of yellow. It is imperfectly known, and on account of its rarity, has only been described by Berzelius:—" Its characters resemble those of pure molybdic acid, but treated with soda, it sinks into the charcoal, leaving a residium of protoxide of iron on the surface. It occurs with the sulphuret of molybdena at Nummedalen in Norway, and at Loch Creran in Scotland"—(*Vide* Phillips, p. 249).

Tellurium is likewise an exceedingly rare metal, about the colour of tin, nearly as fusible as lead, and with a specific gravity of 6.2.

Native tellurium (*gediegen tellur*, Leonh.; *gediegen sylvan*, Werner; *tellur natif auro ferrifère*, Haüy) is of a tin-white colour, passing into metallic-grey. It occurs in minute crystals, the primary form of which is unknown. Analysis, tellurium 92.55, iron 7.2, gold 0.25. It burns with a green flame, on exposure to a great heat, and is almost entirely volatilized in a white vapour with a pungent acrid odour. It has only been found in Facebay in Transylvania. Another variety containing the same ingredients has received the name of *graphic tellurium*. It consists of tellurium 60, gold 30, silver 10. It has only been found at Offenbaya in Transylvania. A third variety, in which lead enters into the composition (*plumbo-auriferous-tellurium, yellow tellurium,* Phillips), is found at Nagyaj in Transylvania, which, on analysis, yielded tellurium 44.75, gold 26.75, lead 19.5, silver 8.5, sulphur 0.5—*Klaproth*. There is also another variety, which contains above

50 per cent. of lead, duller in colour, whence it is called *black tellurium*. Upon analysis, it was ascertained to be composed of tellurium 32.2, lead 54, gold 9, silver 0.5, copper 1.3, sulphur 3. It is likewise found at Nagyaj in Transylvania.

TIN has never been found pure. It is the lightest of the ductile metals, is of a whitish colour, more tenacious than lead, very fusible and elastic.

* * * * *

Some years since, several pieces of pure tin were found in different localities, which gave rise to an opinion, that tin occurs in the native state, but from authenticated sources of information, this erroneous supposition has been dropped, as the places where the specimens were found were the sites of some old smelting houses.

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Oxide of tin (zinnstein, Leonh.; *etain oxydé*, Haüy; *tinstone*, Jamieson) occurs nearly colourless, or of a reddish-brown colour, and in both cases it is nearly transparent. It rarely occurs massive; generally, however, crystallised in the crevices of veins. The primitive form of the crystal is the obtuse octohedron, but the natural crystals are prismatic (the planes of the prism arising from the replacement of the later solid angles of the primary octohedron by six-sided planes). It gives sparks with the steel, and decrepitates strongly before the blowpipe. It belongs exclusively to the oldest primitive rocks, and is found in veins and beds associated with quartz, mica, steatite, topaz, phosphate of lime, pyrites, &c. It is principally found in Cornwall, where it is worked to advantage, and has been a source of considerable benefit to this country in general for several centuries. It likewise occurs in the Erzgebirge, in different parts of France, in Sumatra, and Greenland. The fibrous variety (*wood tin)* appears to have arisen from the partial destruction of this variety. It occurs in most of the stream works in Cornwall.

Granular tin is a third variety, found in loose globular masses, sometimes imbedded in the gangue or walls of the vein, and at other times loose in the sand of rivers, in pieces varying in size from a grain to the size of the fist. It is found in Cornwall in this state, also in Chili and Mexico, and is frequently accompanied by grains of gold.

Sulphuret of tin (*tin pyrites*, Phillips; *zinnkies*, Leonh.) occurs of a steel-grey colour, and sometimes also yellowish-white or yellow. It has sometimes been called bell-metal ore, on account of its resemblance in colour to that metal. It consists of 26.5 tin, 30 copper, 12 iron, and 30.5 sulphur. It has only been found in Cornwall, in the parish of St. Agnes.

TUNGSTEN is a hard metal, of a light steel-grey colour, possessing a specific gravity of 17.22. It has not been found in the pure state, but only in the state of an acid combined with iron, (*wolfram*), or with lime, (*tungsten*.) Tungstic acid consists of 80 tungsten, 20 oxygen—(*Vide* Gmelin's Chemie).

Oxide of tungsten. Imperfectly known, and described only in "Silliman's Journal," October 1821. Colour—orange to chrome, yellow to yellowish-grey. Appearance—massive, with some appearance of regular form. Specific gravity 6. Tests—unalterable before the blowpipe—insoluble in acids—soluble in warm liquid ammonia, and is precipitated white by acids; the precipitate, by standing, again assumes the yellow colour. It occurs in Baltimore in North America.

Tungstate of iron (*wolfram*) occurs of a brownish-black or brown colour, massive and crystallised. The structure is lamellar. It contains a small proportion of manganese. It occurs only in primitive rocks in Saxony and Bohemia.

Tungstate of lime (*tungsten*) is of a greyish or yellowish-white colour, translucent, occurring crystallised and massive. It becomes opaque before the blowpipe, but does not melt. It occurs in primitive rocks in Cornwall, Sweden, Saxony, and Bohemia.

TITANIUM has rarely been reduced to the metallic state, on account of the extreme difficulty which attends its reduction, but when completed the metal is of a copper-red colour. It occurs in a variety of forms, but its only use is the production of a rich brown colour for the purpose of painting porcelain, which has, however, fallen into disuse on account of the want of uniformity. Its specific gravity is about 4.0.

Oxide of titanium comprises several varieties of this class, as under, agreeing in composition, but differing in outward appearances and specific gravity. The two varieties are—Anatase and Titanite.

Anatase (*octœdrit*, Werner; *anatas*, Leonh.; *titâne anatase*, Haüy; *octohedrite*, Jamieson) occurs of a greenish-grey or reddish-brown colour, crystallised in the form of an octohedron with equal faces, with lamellar structure, and splendent lustre. It is generally semi-transparent, and frequently opaque. Its specific gravity is 3.8. It is a rare mineral, found principally near Oisans in Dauphiné, in Norway, and it is reported as having occurred in Cornwall.

Titanite (*rutil*, Leonh.; *titane oxydé*, Haüy) occurs of a reddish-brown colour, crystallised in prisms which are opaque, with a specific gravity of 4.4. It occurs with quartz at Cairnghorm, and Bengloe in Scotland; near Snowdon and Bedgellart in Wales; near St. Austell in Cornwall; on the continent in the quartz of Mount St. Gothard, at Oisans in Dauphiné; and also in Bohemia, Norway, and Hungary. It is generally found disseminated in slender crystals in transparent quartz, also forming slender crystals between prisms of quartz, of which I have seen beautiful specimens from the Alps.

Iserine (*iserin*, Leonh.) occurs of a black colour, passing into a dark brown. It occurs granular, sometimes strongly magnetic, with a semi-metallic lustre. It occurs in the sand of the small river Iser in Siberia (whence its name), and also in the Riesengebirge—Dr. Traill found it in the sand of the Mersey near Liverpool. There are also other varieties of the preceding species, viz.:—

Nigrine, of a brownish-black colour, occurring in small angular masses, with lamellar structure, and externally shining. It is not magnetic. It occurs in primitive rocks in Transylvania, associated with hyacinth in Ceylon, and in the Uralian mountains.

Menaccanite (*menaccan*, Leonh.) occurs of a greyish or blackish colour, in small grains, with a glistening lustre. It is slightly magnetic, and very brittle. It was originally found near Menaccan in Cornwall, and is now found at several other places in that county.

Silicate of titanium (*crichtonite*) occurs in small rhomboidal prisms, perfectly black, opaque, and shining. It is principally found with anatase in Dauphiné.

SPHENE, OR SILICO-CALCITE OF TITANIUM (*sphen*, Leonh.), occurs of a greyish, reddish, or yellowish-black colour, generally amorphous, and sometimes in small rhombic prisms, slightly translucent on the edges. It occurs near Ben Nevis in Scotland, and in the Shetland islands; on the continent it is found in the department of Pûy de Dome, in volcanic rock; and in Norway and Sweden in granite.

Cerium has recently been added to the list of metallic elements, by Vanquelin, who succeeded in reducing it to the metallic state. It is harder and more brilliant than pure cast-iron. The specific gravity varies from 4.2 to 4.9.

Silico-oxide of cerium (*cerite*, Jamieson and Phillips) occurs of a rose-red colour, approaching brown, massive or disseminated, opaque, and difficultly frangible. Analysis of Vanquelin—

Oxide of cerium	67.0
Silex	17.0
Oxide of iron	2.0
Lime	2.0
Water and carbonic acid	12.0
	——100.0

It is found in the primitive rock of the neighbourhood of Riddarhytta in Sweden, associated with bismuth and lead.

Allanite (*cerium oxydé silicifère noire*, Lucas) is a rare mineral, occurring of a brownish-black colour, in prismatic crystals, with a semi-metallic appearance. It is opaque, whence it is easily distinguished from yttrite (gadolinite), and also by its colour. It was discovered in West Greenland, by Professor Giesecké, but derives its name from Mr. Allan, who first described it.

Orthite can be distinguished from the preceding varieties on account of its being found in seams (in felspathic rock), and not granular or crystallised. Analysis of Berzelius—

Cerium	19.50
Protoxide of iron	12.44
——— manganese	3.44
Yttria	3.44
Silex	32.00
Alumina	14.80
Lime	7.84
Water	5.36

It occurs in the neighbourhood of Fahlun in Sweden.

YTTROCERITE varies in colour from grey to red and violet. It is found in amorphous masses, investing other minerals, and opaque. Its specific gravity is 3.447. It occurs with the preceding variety at Fahlun, in the mine of Finbo.

* * * * * *

Cerium likewise occurs in combination with the fluoric acid, in various proportions; also with yttria. The colour is generally yellow, but in some cases also red. The analyses which have already been made have not been satisfactory, and the composition cannot, on that account, be correctly asserted.

URANIUM is a brittle metal, of a reddish-brown colour, but has never been observed in the metallic state. Specific gravity 6.

Phosphate of uranium (*uranglimmer*, Leonh.; *uranite*, Phillips) occurs generally of an emerald-green colour, but not unfrequently also of shades of yellow and yellowish-brown. It is a singular fact also that these two different shades of colour are often met with in the same specimen, or even in the same crystal. It is slightly translucent, verging on transparent but generally opaque. It occurs in thin lamellar plates, and crystallised (the primary form is the right rhombic prism). It occurs near St. Agnes in Cornwall, also in several other mines in that county, on primitive rock; near Limoges in France, and Baltimore in Maryland. It effervesces in nitric acid.

Oxide of uranium (*uran-ochre*, Phillips; *pecherz*, Leonh.) occurs of a greyish or blackish colour, in globular masses, massive and disseminated, also pulverulent. It has a vitreous appearance, and is slightly translucent on the edges. It occurs in the Tincroft mine with uranite.

COLUMBIUM is one of the late discoveries in metallurgy, and was formerly considered as a different metal from *tantalium*, which, however, has been proved by Dr. Wollaston to be the same. It has only lately been reduced to the metallic state, when it assumes a dark grey colour. Specific gravity 6.0. It occurs in combination with oxygen in the mineral known by the name of *columbite* (*tantalite*, Jamieson), the colour of which is bluish-black; and it occurs in small flat quadrangular prisms, striated longitudinally—also in crystalline masses. The analysis of a specimen by Wollaston yielded—oxide of columbium 80, oxide of iron 15, oxide of manganese 5. It occurs at Bodenmais in Bavaria, and in Connecticut in North America; it likewise occurs in combination with yttria (*yttrotantalite*), of an iron-black colour, occurring in small angular pieces. Specific gravity 5.1. The constituent parts are oxide of columbium 45, and yttria 55. It is found associated with yttrite at Ytterby in Sweden, and at Rickerlamsan in Greenland.

CHROME is a brittle metal, of a greyish-white colour, and 5.9 times heavier than water. It is only found in the state of an oxide or an acid, when it forms a constituent in the ruby. It is used for producing a green colour in the porcelain manufacture.

Oxide of chrome occurs of a bright green colour, either pulverulent or crystalline compact. It occurs in the island of Uist, one of the Shetland group; also in Burgundy. The green colour is changed to yellow by heating, and it is soluble by boiling in the alkalies, imparting to them a green colour, which disappears upon continuance of the heat, and the oxide is precipitated.

COBALT occurs in a variety of forms in nature, though not in the native state. It is of a grey colour, possessing considerable magnetic properties. Specific gravity 7.7. It occurs in both primitive and secondary mountains, and is employed for producing a fine blue colour in the glass and porcelain manufactures.

Arseniate of cobalt (bright white cobalt, Phillips) occurs of a yellowish-white colour, crystallised in the form of the cube, and the modifications of that figure. It occurs in primitive rocks in Norway, Silesia, and Sweden. Analysis—cobalt 44, arsenic 55, and sulphur 0.50.

Grey cobalt contains an additional portion of sulphur, and is of a greyish-black colour externally. It is found in amorphous masses, but never crystallised. The analysis of Stromeyer determines it to be composed of—cobalt 33.10, arsenic 43.47, iron 3.02, sulphur 20.08, water 1.33. It occurs near Dolcoath in Cornwall, and in Bohemia, Saxony, Silesia, France, and Hungary. A second variety occurs botryoidal, and crystallised in cubes and octohedrons, possessing a tin-white colour. It contains cobalt 20.31, arsenic 74.21, iron 3.42, and copper 0.15. It occurs in Saxony and Bohemia.

Oxide of cobalt (bloom of cobalt, Phillips) occurs of a rose-red colour, and sometimes greyish or brownish grey. It occurs investing and in botryoidal masses, and also in acicular prisms—it is soft. Analysis of a specimen from Dauphiné—cobalt 30, arsenic 22, oxygen 11, and water 27. It occurs in Cornwall in the Botallac mine, near Land's End; near Edinburgh, and in Dauphiné, Hungary, and Saxony.

Sulphuret of cobalt (cobalt sulphuré, Lucas) occurs of a yellowish or greyish colour, massive and botryoidal. It fuses on charcoal before the blowpipe, yielding sulphurous odours. It occurs near Bastudes in Sweden.

Sulphate of cobalt (red vitriol, Phillips) occurs of a rose-red colour, stalactitic, or investing other minerals. Analysis of a specimen by Koppen—cobalt 38.71, sulphuric acid 19.74, and water 41.55. It occurs in the Tyrol and Suabia.

NICKEL occurs of a tin-white colour, is attractable by the magnet, ductile and malleable, difficultly fusible, and nine times heavier than water.

Native nickel (gediegen nickel, Leonh.; *haarkies,* Werner; *nickel natif,* Haüy) occurs in filaments of a yellowish or brownish-grey colour, flexible, but not magnetic. It contains a small portion of arsenic. It occurs near St. Austell in Cornwall, in Saxony and Bohemia.

Arsenical nickel (copper nickel, Jamieson; *kupfer nickel,* Leonh.) occurs of a reddish or yellowish-red colour, which tarnishes on exposure. It occurs massive, botryoidal, and dendritic, somewhat brittle and shining. Analysis—nickel 44.2, arsenic 54.7, with a slight portion of iron and sulphur. It occurs in primitive rocks in Cornwall, Saxony, Bohemia, France, and the United States.

Arseniate of nickel (nickel ocker, Leonh.) accompanies arsenical nickel is of an apple-green colour, forming a coating to that mineral. It is soluble in acids, and has most probably originated from the spontaneous decomposition of arsenical nickel. The localities are the same.

LEAD occurs of a bluish-grey colour, and is malleable, ductile, and soft, with a specific gravity of 11.3. It is used in a variety of ways, too numerous to notice—the most useful being in medicine, in the formation of several alloys, and printing types.

I. *Sulphuret of lead (galena,* Phillips) occurs of a lead-grey colour, massive, and of lamellar structure; also crystallised in the form of the cube and regular octohedron. It possesses a brilliant metallic lustre, and is very brittle. Analysis of a specimen from

Wales—lead 78, sulphur 21. It decrepitates before the blowpipe, emitting a sulphurous odour, and finally melts into a metallic globule. It occurs in primitive and secondary mountains in beds, associated with iron, copper, zinc, and silver; the principal localities being Durham, Wales, Cornwall, the Vosges in France, the Saxon Erzgebirge, and North America. Phillips notices the several varieties separately, and enumerates *granular, compact, specular, antimoniferous, argentiferous,* and *super-sulphuret,* as varieties. The metal is procured by pounding and roasting the ore, in order to drive off the arsenical and sulphurous vapours. The annual produce of Great Britain is 50,000 tons.

II. *Blue lead* (*blaubleierz,* Leonh.; *plombbleu,* Brong.) is a variety of sulphuret of lead. It occurs of a lead-grey or indigo-blue colour, massive, in six-sided prisms, and is rough and dull. Specific gravity 5.4. It occurs in Cornwall, and at Zschoppau in Saxony.

III. *Bournonite* (*schwarz spiesglaserz,* Werner) is of a steel-grey colour, with a shining lustre. It occurs crystallised in rectangular prisms, possessing a lamellar structure. Is possesses the same property of decrepitating before the blowpipe as the common sulphuret. It occurs in the parish of Endellione in Cornwall.

Oxide of lead (*native minium,* Smithson) occurs of a scarlet colour, amorphous, and rarely pulverulent. It is supposed to arise from the decomposition of galena. It occurs at Badenweiler, and in Siberia.

Carbonate of lead (*weiss bleierz,* Leonh.; *plomb blanc,* Brong.) occurs of a yellowish or whitish-yellow colour, in tabular crystals, and in prisms striated longitudinally, and closely aggregated, also massive. It possesses the property of double refraction. Specific gravity 6.72. It effervesces in muriatic acid. It occurs in several mines in Durham, Wales, Cornwall, and in Saxony, Bohemia, Silesia, and Hungary. It occurs with a slight proportion of copper in some localities.

Muriate of lead (*murio-carbonate of lead,* Phillips; *hornblei,* Werner; *plomb muriaté,* Brong.) occurs of a greyish colour, passing into yellow, and crystallised in four-sided rectangular prisms. It is transparent or translucent, soft, and easily frangible. Specific gravity 6.0. It occurs in Germany, near Badweiler, and in the United States.

Phosphate of lead occurs of a green, yellowish-green, or yellow colour, crystallised in six-sided prisms, easily frangible, and transparent. Specific gravity 6.4. It occurs in Cornwall, the Hartz, Saxony, and Bohemia.

Arseniate of lead (*plomb arsenieté*) occurs of a pale yellow colour, passing into grass-green, translucent, rarely transparent, and easily frangible. Specific gravity 5.6. It occurs in Cornwall between Redruth and Truro.

Sulphate of lead occurs of a greyish-white colour, crystallised in rhombic prisms, with diedral summits, and transparent. It is brittle. Specific gravity 6.3. It occurs near St. Ives in Cornwall, in the Parys mine in Anglesea, and in the Hartz mountains.

Molybdate of lead (*gelbes bleierz*, Werner; *plomb jaune*, Brong.) occurs of a yellow colour, and crystallised in acute octohedrons, translucent, and brittle. It rarely occurs massive. It occurs at Bleiberg in Carinthia, and in the Tyrol, Austria, and Transylvania.

Chromate of lead (*rothbleierz*, Werner; *plomb rouge*, Brong.) occurs of an orange-red colour, crystallised and massive, translucent, rarely transparent, and brittle. It gives a green colour to borax before the blowpipe. It occurs in the gold mine of Beresof in Siberia.

ZINC is of a bluish-grey colour, possessing a small degree of tenacity, is ductile, malleable, and seven times heavier than water. It is used in medicine, and for coins in China.

Sulphuret of zinc (*blende*, Phillips; *blend*, Leonh.; *blende*, Brong.) occurs of a brownish, yellowish, or reddish-brown colour, amorphous, and crystallised in a variety of forms, the primary being a rhombic dodecahedron. It occurs in primitive and secondary rocks in Cornwall, near St. Agnes, and in Scotland and Durham.

Oxide of zinc occurs of various shades of red, massive, disseminated, and micaceous. It is translucent, brittle, and has a specific gravity of 6.2. It occurs in New Jersey in North America.

Carbonate of zinc (*calamin*, Leonh.; *zinc carbonaté*, Haüy; *calamine*, Phillips) occurs crystallised, compact, earthy, and pseudomorphous; the crystallised varieties of a green colour, and of the form of acute rhomboids. The latter varieties of a yellowish-brown colour. It occurs in beds in secondary limestone in Somersetshire, Derbyshire, and Durham.

The ores of zinc contain a new chemical metallic element, *cad-*

mium, which never occurs pure in nature. The presence of it in the carbonate of zinc can be detected by placing a small quantity, pounded, on a piece of platina foil, and by passing this over the blue flame of a candle, the cadmium will be reduced and deposited in the form of a reddish-brown protoxide on the platina.

CLASS III.—INFLAMMABLE MINERALS.

Several of these substances are found in a liquid, others in a solid state, when they are easily broken. They are only about twice as heavy as water. Most of the metals when altered by combustion, acquire an increase of weight, whereas this class are sensibly diminished in weight by the same process.

CARBON (*diamond*). The combustible properties of this rare mineral being fully known, it deserves the first place among this class They are either colourless, or slightly tinged with yellow, blue, or yellowish-green. They are always found in crystals, varying in size and in form, and varying from transparent to nearly opaque. When heated they become phosphorescent, and are the hardest of all substances. They burn at a heat inferior to the melting point of silver, and yield as much carbonic acid as charcoal, whence they appear to consist of pure carbon. The diamond region of India extends over a tract of country reaching from Bengal to Cape Comorin, the principal being at Golconda. Very fine diamonds have been found at Pastael, twenty miles from Golconda, among which may be enumerated the Pitt, or Regent Diamond. The diamond mines of Brazil are situate due north of the River Janeiro, where they are found imbedded in the sandstone grit, of which the country is principally composed; also in the mud of the rivers. The largest diamond extant is in the possession of the Rajah of Mattan, in the Island of Borneo; and nearly resembles an egg, with an indented hollow near the smaller end.

COAL comprehends a variety of carboniferous minerals, generally speaking, of great importance and mineralogical interest.

Common coal (*steinkohl*, Leonh.; *charbon de terre*—French) occurs massive only, of a shining black colour, generally splendent, though sometimes also dull. It occurs in secondary districts of country, particularly in the counties of Durham, Northumberland, Staffordshire, and Gloucestershire, in England; also in South Wales and in Flintshire; in Ireland; in Belgium in the environs of Liège, in France and Germany; and North America. It contains a great number of vegetable remains, particularly of those of the fern tribe; and in several instances whole trunks of trees, several feet in height, have been found imbedded in it.

Anthracite coal (*blind coal,* Phillips; *glanzkohle,* Leonh.; *anthracite,* Brong.) occurs massive, slaty, and columnar, of an iron-black colour, very splendent, and sometimes tarnished. Some varieties possess a very splendent variegated appearance. It occurs in the Staffordshire district, and also in South Wales. Anthracite is the most abundant coal of North America. It burns without either smell or flame, and on that account can be easily distinguished from common coal.

Cannel coal (*kennel kohle,* Leonh.; *houille,* Haüy) occurs massive, of a greyish-black colour, a resinous lustre, and flat conchoidal fracture. It decrepitates when burnt, but yields a bright flame. It occurs principally as the uppermost bed of the coal deposits in this country and Scotland, and is used in the place of candles in some places, whence its name.

Jet (*pechkohle,* Leonh.; *jayet,* Haüy) occurs of a dull black colour, resinous in lustre, and with a perfect conchoidal fracture. It occurs in masses similar to layers in the shale of the environs of Whitby in Yorkshire, and is found at many places in France and Germany. It burns with a bituminous odour and greenish flame.

Brown coal, or wood coal (*braunkohle,* Leonh.; *lignite,* Werner) occurs of various shades of brown, sometimes earthy, but more commonly fibrous. It burns with a weak flame and strong odour, resembling that of peat, when burnt. It yields readily to the knife. It occurs near Bovey in Devonshire, whence it has received the name of Bovey coal; also in Thuringia, France, Bavaria, Saxony, and Silesia.

BITUMEN occurs in three varieties; viz.—

1. *Earthy bitumen* (*erdiges erdpech,* Leonh.; *bitume glutineuse,* Haüy) occurs of a dull blackish-brown colour, earthy, sectile, and soft. It burns with a clear flame and agreeable odour. It occurs

at Carharrack Mine in Cornwall, in France, the Hartz Mountains, and Asia.

2. *Compact bitumen* (*schlackiges erdpech*, Leonh.; *bitume solide*, Haüy; *asphalt*) occurs of a brownish-black colour, massive, brittle, and of a shining resinous lustre; specific gravity is but little more than water. It occurs in Cornwall, France, Germany, and in the Dead Sea.

3. *Elastic bitumen* (*elastiges erdpech*, Leonh.; *bitume elastique*, Haüy) occurs of various shades of brown, and is soft and elastic, about the weight of water, possessing a strong bituminous odour. It burns with a large flame and much smoke, and has received the name of " mineral caoutchouc," on account of its elasticity.

Bitumen is one of the oldest minerals of which we have any record. It was used by the Egyptians for cement, and for embalming.

PETROLEUM occurs of a reddish-black colour, rather thicker than common tar, possessing a disagreeable bituminous odour, and burning with a very thick black smoke. It occurs at Ormskirk in Lancashire, at St. Catherine's Well near Edinburgh, and in the Hebrides; also in France, and plentifully in Persia.

NAPTHA (*le napthe*, Brong.) occurs of a slightly yellowish colour, transparent, burning with a blue flame and much smoke. It is the only fluid which contains no oxygen, and on this account is much used for chemical purposes, to preserve substances which usually ignite when in contact with any substance containing that gas. It occurs in Asia, Italy, Sicily, and America.

AMBER (*bernstein*, Leonh.) occurs of various shades of yellow or light-brown, in roundish masses enclosing insects, either ants, spiders, flies, or the ichneumon—this last is, however, rare. It is generally transparent, possessing strong electric properties. It yields, by distillation, *succinic acid* (or acid of amber, from *succinum*, the Latin for amber), leaving a black shining coal. It belongs to the tertiary formation, and occurs in Germany, Prussia, France, Greenland, Moravia, and occasionally in the gravel near London.

SULPHUR (*schwefel*, Leonh.; *soufre*—French) occurs in a variety of forms, either crystallised, compact, earthy, investing, or cellular. The form of the crystal is the acute octohedron. It possesses a conchoidal fracture, burning with a blue flame and suffocating odour. It is of two formations, *natural* and *volcanic;* the fi occurring in beds in primitive and secondary rocks in Hungary Spain, and Switzerland; and the second, in deposits in the neighbourhood of volcanic districts. The most remarkable deposits are those of Solfaterra near Naples, and the sulphur island in the Japanese Sea. The specific gravity of sulphur is 2.0.

ON THE TERMS USED IN MINERALOGY.

Before concluding this introductory notice of the study of mineralogy, a few words on the terms used, and after that, on the theory of crystallisation, are absolutely necessary. The terms being in many cases exceedingly difficult, the object can be best effected by the annexed alphabetical arrangement.

Acicular	From *acicula*, a needle, signifying long, slender crystals.
Aggregated	When the mineral is constituted of several substances which only adhere together, but can be easily separated. Also when crystals are closely connected, they are said to be aggregated.
Amorphous	Without any determinate form.
Anhydrous	Without water.
Arborescent	In branch-like forms (or dendritic).
Botryoidal	Presenting an aggregation of sections of numerous small globules.
Capillary	Long hair-like substances (viz., native silver) are called capillary.
Cellular	Composed of cells formed by the intersecting of the laminæ and lamellæ.
Chatoyant	(French) possessing a changeable light (viz. cat's-eye).
Coherent	Particles strongly cohering together.
Conchoidal	Relates only to fracture; compact minerals are more or less conchoidal. From *conchoides*, the shell of a fish.
Decrepitate	When a mineral exposed to heat flies with a crackling noise.
Dendritic	*See* Arborescent.
Disseminated	Imbedded in the mass of another substance.

Disintegrated	When a mineral falls to pieces, without any apparent chemical action.
Drusy	When the surface is composed of crystals of the same size, or masses of the same size and form. From the German, *drusen*.
Efflorescence	Minutely fibrous.
Filiform	Synonymous with Capillary.
Foliated	Such minerals as can be cleaved into folia or leaves are termed foliated.
Friable	Easy to be crumbled or broken down.
Gangue	The substance in or upon which a mineral is found, (or matrix.)
Geode	A hollow ball.
Glaucous	Shining.
Hackly	(Relating to fracture) sharp protruding points upon the surface.
Investing	Coating or covering another mineral.
Iridescent	The colour with which the surfaces of some minerals are naturally tarnished.
Irisated	Exhibiting prismatic colours externally or internally.
Lamellæ	The thin plates of some minerals are lamellæ.
Lamellar	(Relating to structure) when a mineral can be cleaved into regular and parallel plates its structure is lamellar.
Mammilated	*See* Botryoidal.
Matrix	*See* Gangue.
Meagre	(Relates to the feel of a mineral)—chalk is meagre.
Nacreous	(Relates to lustre)—pearly.
Pseudomorphous	Minerals exhibiting impressions of the forms peculiar to the crystals of other substances are pseudomorphous.
Pulverulent	In very minute particles.
Ramose	Branchiform.
Reticulated or Retiform	Parallel fibres crossed by other parallel fibres.
Sectile	Between brittle and malleable.
Stellated	When the fibres of a mineral diverge from a centre, the mineral is said to be stellated.
Translucent	When a mineral displays some degree of light, without objects being able to be seen through it, it is then translucent.
Transparent	When objects can be seen through it.
Vitreous	Glassy.

ON STRUCTURE AND THE CRYSTALLISATION OF MINERALS.

The structure of a mineral substance arises from the arrangement of the minute particles of which it is composed, whether it be massive or crystallised. That this is the case is easily proved by the regular formed pieces which present themselves when a mineral breaks on falling upon a hard substance; these can again be divided, and so continued until they can no longer be done without the help of a magnifying glass—the form which is thus produced is the primary crystal. The mechanical division may be accomplished in various ways, either by a knife in the fingers, or by a hammer on a hard substance, by pincers, or by a blow upon the blade of a knife placed in the required position upon any hard substance.

The primary crystals are the following:—

1. Tetrahedron.
2. Cube.
3. Rhombic dodecahedron.
4. Octohedron.
5. Six-sided prism.
6. Parallelopiped.

The same mineral always yields the same primary form from whatever locality it may have been brought.

The numerous crystallisations which we observe in the mineral kingdom are merely modifications of these six primary crystals, but how they deviate from them we know not—most probably, however, by laws to which matter is subject, as affinity, polarity, &c. &c.

A simple instance will be enough to show this. The form of the cube of fluor, by displacing the solid angles, is materially altered; and if we remove layers which are parallel to the angles displaced, we shall at last arrive at the octohedron, which is the primary form. A theoretical argument is the result of these proofs; that as one and the same crystal can only be cleaved into particular forms, so must the whole be composed of similar particles, of the same form. But as the different varieties of minerals differ also in form, they cannot all be reduced to a crystalline primary form. Some are fibrous, resulting from longitudinal adherence of acicular crystals—others are imperfectly lamellar, and in these the natural points are scarcely attainable.

CONCLUSION.

Before concluding this introduction I will state the objects of this science, and give a small outline of the connection which it bears with geology. It is not the mere knowledge of the outward form which renders this study interesting, but it is the connection it bears with other sciences—a knowledge of all of which is required. The principal and most interesting feature which characterises this study is the variety of branches which constitute it. Chemical analysis is one of the most interesting and important; it requires the practical knowledge of all the tests, of the uses of the blowpipe, and the action of acids upon minerals. A knowledge of the structure is likewise interesting, on account of the facts which come under your observation during the trials respecting the mechanical division, and the comparatively open and untrodden field before you. But a knowledge of the mere outward appearances is not to be despised, for many cannot pursue the requisite accompaniments. The varied forms, beautiful colours, and aggregated appearances, with a knowledge of their localities, and a theoretical knowledge of their composition, renders the study interesting, especially to ladies. But the student must know how to apply the tests, and recognise the presence of any ingredient, whether simple or compound. Mineralogy is a sister science with geology, for we can alone judge of the comparative ages of the different metals by the formations in which they occur. The primitive and secondary rocks are those which generally contain the metalliferous beds. The primitive have undergone considerable change, and with the debris of the secondary rocks, the ruins of the primitive have tended to constitute the alluvial formation. But we have not noticed the effects of volcanic action, both on minerals and rocks. The ingredients which are contained in the bowels of the earth are here brought into contact, and acted upon, forming the carbonates, oxides, &c. &c., owing to the gases which are contained; and the deposition of vast masses of volcanic rock, either in fissures through the primitive or secondary, or in immense beds, originates from this.

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